ELECTRICAL REVIEW

[ILLUSTRATED.]

A WEEKLY JOURNAL OF

ELECTRIC LIGHT, TELEPHONE TELEGRAPH AND SCIENTIFIC PROGRESS.

Vol. 9. No. 23. WEEKLY. NEW YORK, SATURDAY, FEBRUARY 5, 1887. $3 per annum. Single Copies, 6 Cents.

Copyright, 1887, by ELECTRICAL REVIEW PUBLISHING COMPANY, 23 Park Row, New York.

Entered at Post Office, New York, as Mail Matter of the Second Class.

Mr. Rankin Kennedy's Dynamo.

Mr Rankin Kennedy, of Glasgow, is the author of a dynamo machine, the construction of which is shown in principle by the Fig. 1, where *N* and *S* represent the poles, while the winding is surrounded by an iron box, which surround the magnetic field. In these machines, the poles *N* and *S* are tubular projections of elliptic form through the arbor, which carries the induced circuit in passing. These projections are cut off and funnel shaped at the ends of the same diameter, so as to leave two polar pieces of the same name horizontally opposed one to the other on the same side of the armature, as can be seen in *S S* on Fig. 2. This latter represents a section of the machine frame; *B C* represents the iron box, and *A S* are the projections. On the other side of the armature the polar projections are placed opposite one another, according to a vertical diameter, as one may see on Fig. 3, where *D* represents a part of the armature, and *E* the machine commutator. This arrangement gives to the dynamo four poles placed alternately on each side of the armature. The magnetic circuit is closed by the outside box so as to prevent the producing of an exterior field.

The inside construction of the machine is made clear by Fig 4. They can give any even number of poles to this dynamo.

The Origin of Continuous-Current Transformers.

We (*L'Electricien*) have hitherto believed that M. Cabanellas was the first inventor of the continuous current transformers.

It is our duty to admit, and we do it very willingly, that the idea of this apparatus belongs to M. Gramme, as it is established beyond doubt by a pamphlet written in 187 by our regretted colleague, Alfred Niaudet, and which we owe to the kindness of the publisher, M. Hippolyte Fontaine. We think it will be interesting to our readers if we reproduce in full the passage relating to this invention (pp. 14, 15 and 16), which will remove all doubts in this respect. It is to be noted that the author had foreseen the two methods of inverse transformations. Let us render, therefore, to Cæsar * * *

TRANSFORMATION OF ELECTRICITY FROM QUANTITY TO TENSION BY MEANS OF THE MACHINE.

It is known that the induction coils first created and studied by MM. Masson and Breguet (*Annales de Chimie et de Physique*, 1842), and improved with the aid of M. Ruhmkorff by the efforts of so many physicists, are appliances destined to transform electricity in quantity into electricity of high tension. Thus a bobbin of ordinary size is sufficient to transform the continuous inducing current of two Bunsen elements into an intermittent induced current, giving sparks of 1 centimeter in length. We are certainly within the truth if we say that the tension of the second current is one hundred thousand times greater than that of the former.

M. Gramme has recently shown (*Comptes Rendus de Academie des Sciences*, November 23rd, 1874) that his machine may likewise serve to transform electricity, and to give it a higher tension.

For this purpose he uses a kind of non-symmetric divided ring; that is, the series of even bobbins is made with a fine wire, whilst the odd bobbins are formed of thick wire. This ring is placed between the poles of a magnet.

Suppose that we pass the current of two Bunsen elements into the thick wire; the ring will begin to turn as is explained above But under the influence of this rotation an ordinary current (such as is given by Gramme machines) will be produced in the bobbins coiled with fine wire. There is reason to expect that the tension of the second current will be greater than that of the first, and this is what experience shows. In an apparatus thus arranged the tensions of an exciting current and of the induced current are as 1.8.

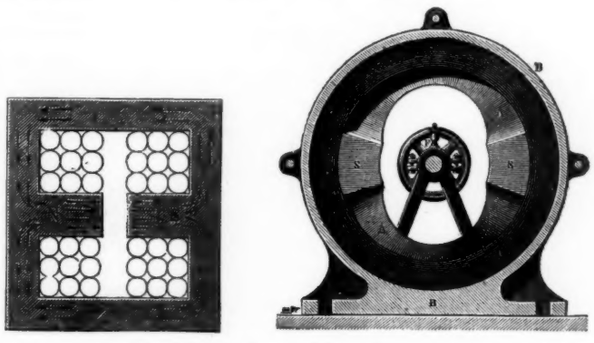
We have here, as is seen, a transformation of the electricity and a change of tension like that produced by induction coils; but instead of the enormous proportions of the inducing and induced currents, which may be appreciated but which cannot be measured, we find tensions having proportions which are easy to measure, and probably easy to calculate as soon as the question has been studied a little more closely.

We may say that the transforming capacity of the induction coil is quite different from that of the Gramme machine, but precisely on this account we may hope that the latter will render new services.

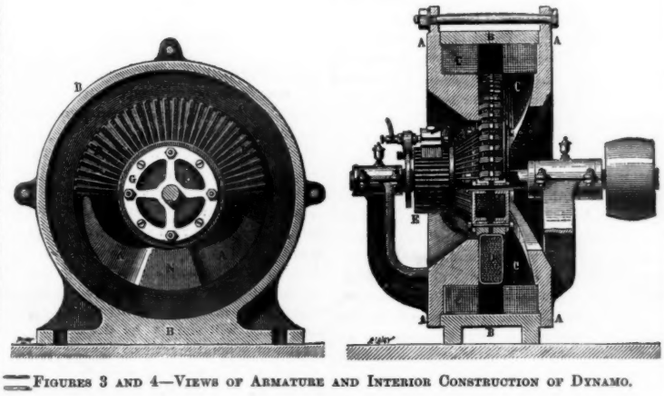
We give only one instance: the current of two Bunsen elements transformed by the system just explained will give a current equal in tension to that of 16 Bunsens, and consequently a current equivalent to that of 30 Daniells, with which we can easily telegraph to a great distance.

It is important to remark that the Gramme apparatus enables us not merely to convert electricity of a lower tension into electricity of a higher tension (as just shown) but also to do the reverse, that is, to transform the tension current of 30 Daniells into the low tension current of 2 Bunsens.

It is certain that in these transformations there is no metamorphosis, but rather a loss greater or less, and we may say, paraphrasing the mechanical truth, "What we gain in tension we lose in quantity, and inversely."



FIGURES 1 AND 2—RANKIN KENNEDY'S NEW DYNAMO.



FIGURES 3 AND 4—VIEWS OF ARMATURE AND INTERIOR CONSTRUCTION OF DYNAMO.

Workshop Illumination.

We learn from *Industries* that Herr Cohn, of Breslau, in an address to the members of the Naturalists' Association, at Berlin, made an interesting statement concerning the lighting of workshops. He has found, as the result of a long series of observations and experiments, that no working place is to be deemed well lighted by artificial means that has not a minimum illumination of 10 meter candles. By meter candle he understands the degree of illumination to be found upon a small disk of paper set one meter distant from a standard candle light. With less than this, he says, the workman's efficiency is diminished, and, in course of time, his sight is seriously weakened.

Electro-motors and Their Government.

BY W. M. MORDEY.

The very interesting article by Professors Ayrton and Perry, in support of their well-known views on electric motors, calls for some remarks from me, as a paper of mine in the *Philosophical Magazine* for last January, and a discussion in which I took part in the columns of the *Electrical Review* during the summer of this year, appear to be to some extent responsible for eliciting from Profs. Ayrton and Perry this statement of their adherence to their original views.

The questions sought to be answered affirmatively by their article are three in number:

1. When they read their paper in 1883, before the Society of Telegraph Engineers, were they acquainted with the principles of self-governing shunt motors?

2. Is their method, published at the same time of obtaining a constant speed, independent of the load, by means of differential winding, necessary?

3. Is their principle that in a motor the armature ought to be magnetically much more important relatively to the field magnet than it should be in a dynamo, right?

On the first point I am saved some trouble as I can refer to the discussion between myself and "A Student," who, although unknown to the professors, is stated to have clearly expressed their views.

As they now state that they were acquainted with this principle in 1882, I must modify my statement, and can now only express my surprise that the paper of 1883 does not contain a single word to show that they were aware of the all-important fact which it appears was taught to their students in 1882. Let it be remembered that in their paper they were dealing with motors generally—the paper was a broad one in its title and aims. There is nothing in it to show that they restricted the range of their enquiries. To quote from the correspondence already alluded to, the paper "was not called 'Ayrton and Perry electro-motors and their government,' but 'Electro-motors and their government,' and in approaching the subject of government, the authors were free to refer to previous knowledge on the subject; in fact, it was incumbent on them to do so. And what did they say? 'They had made many experiments with motors of different sizes and different types, and they knew all that was known on the subject.'" And yet there is not one word to even distantly intimate that very good self-regulating simple shunt motors could be constructed. On the contrary, they say: "We will consider theoretically the general principles involved in the government of motors"—not of motors of a certain kind be it noted, but of motors generally—and then they proceed—"Governing: A motor may be governed to run at the same speed whatever work it may be doing, *in one or other of two distinct ways.*" (The italics are mine.) "First, the power may be cut off in proportion as the work is cut off; or, second, a brake may be employed to replace the useful load removed." I need not say more on this point, except that it is now stranger than ever to

me how the learned professors entirely passed over a principle of regulation of the utmost importance, when they were engaged in an examination of the subject which was evidently as complete as they could make it. Nay, more, the paper has since been separately published without addition or alteration, and used, I believe, by their students as a sort of text-book of all that is worth knowing on the government of all electric motors. I am sure that under these circumstances, the professors will acknowledge that I had very strong grounds for the opinion which I ventured to express.

With regard to the second point, viz., whether their differential winding method is necessary. I believe that under some circumstances it would be useful; but that the cases where its employment would be necessary, on constant E.M.F. mains, will be few and far between. The compounding of dynamos is necessary: first, from the extreme sensitiveness of incandescent lamps to small changes of E.M.F.; secondly, to compensate for the variation of speed of even the best mechanically governed engines: and, thirdly, to compensate for loss of potential in conducting leads. In motors even a larger percentage variation of speed than is given by shunt motors is usually allowable, as is admitted by Profs. Ayrton and Perry. The other two causes for compounding do not apply in the case of motors. The fall of potential in the mains is provided for by the compounding of the dynamo, and extreme regularity of speed is not likely to be often demanded.

Profs. Ayrton and Perry refer to Sprague's re-invention of their differential winding. I may be allowed to mention that Sprague's claim to having last year discovered the principle of inverse variation of strength of field for purposes of regulation is ridiculous in face of Ayrton and Perry's differential system, and that two years and a half ago I and my assistant, Mr. Watson, patented a system of regulation which, although summational instead of differential, was based on the principle of inverse variation of field excitation.

Poor Mr. Sprague—not the Sprague of Birmingham, but the Sprague of New York—is to be condoled with on having taken out patents (1) for a law of nature probably known previously to all workers with motors, namely, that a shunt motor runs quicker when the field is weakened; and (2) for winding the coils of motors according to the mathematical proportion published in 1884 by Prof. S. P. Thompson, in Equation LIV. of his book!

Before referring to the main question dealt with by Profs. Ayrton and Perry—that of the relative dimensions of armature and field—a word must be said about an argument used by them which I have read and re-read with an ever-increasing crescendo of astonishment. They say that such motors as I referred to in the *Philosophical Magazine* could not be used because they required 130 amperes to do certain work. From this they argue that as the use of such a current in the case in question would reduce the efficiency of transmission by 27 per cent. per mile, these motors "could not be used in the electric transmission of power." The motor in question was a low-tension machine intended for use on ordinary lighting mains of short length, and the current under these circumstances was necessarily large. Surely it is not necessary to explain to the professors that the current is a mere matter of winding. It is difficult to see why the argument and calculation have been inserted in the article, or what possible bearing they have upon the question of motor construction and regulation. However, lest any misunderstanding should arise on this point, it may be mentioned that for a considerable time a 40 horse-power Victoria motor, of the exact type which Profs. Ayrton and Perry say "could not be used as a motor in electric transmission of power," has been in successful operation on a line of six miles of wire, with a loss of only 3.3 per cent. per mile of the power supplied to the motor. And that is in a case where there is no need to economize power, as the generator is driven by a super abundant water supply; the motor is, of course, wound to work at a high instead of a low difference of potential, but in principle it is in no respect different from the machines adversely criticised.

And now we come to the main object of the learned Professors' article, the question as to whether they were right in 1883 in teaching that in a motor the armature ought to be magnetically much more important relatively to the field-magnet than it should be in a dynamo.

In everything which they have written on the subject they appear to overlook the fact that there are many considerations of greater importance than lightness of weight. Their whole argument is directed to the question, not what is the best motor, but what is the lightest loco-motor. Because a loco-motor on a telpher or tramline, or on an electric launch, has to propel itself as well as to move something else, it does not follow that there are no other motors worthy of consideration. A railway locomotive is not the only kind of steam engine, nor would it be the best for pumping, for driving shafting, or for marine purposes.

One of their objections to the Victoria motor of my *Philosophical Magazine* article is that they suppose the ratio of its weight in pounds to the useful horse-power given out by it "far exceeds 60." I do not know on what they based this supposition. As a matter of fact, the figures given were not "far exceeded," the ratio being not quite 70. But it must be remembered that the motor in question was made for stationary work, and no special effort to reduce weight in proportion to output had been made in its construction. Indeed, my opinion is that the motor was too light, and not too heavy—it had too much copper on it. But this shows that it is quite possible to construct very good motors of comparatively light weight without resorting to what I maintain is the objectionable feature of a powerfully-magnetized armature in a weak field.

In designing a motor for any given purpose, the following conditions require to be kept in view in nearly all cases: (*a*) The speed should be low; (*b*) sparking should be a minimum; (*c*) when the load is varied no movement of the brushes should be necessary; (*d*) the economy should be high; and (*e*) in the special case of loco-motors the weight should not be excessive.

In all other applications than loco-motors, the weight is of no more importance than it is in dynamos or steam engines; and even in the special case of loco-motors, as, for instance, on tramcars or electric launches, where accumulators have to be carried, it would probably be found that, merely as a matter of weight, the additional cells which must be carried to make up for the lower efficiency of light motors would more than cancel the gain of weight in the motor; while the charging and maintenance of the extra cells must be put down as so much dead loss. Then, again, with such motors as I advocate, there is a very considerable simplification of the arrangements. In almost all cases, self regulating or governing devices are quite unnecessary. For instance, a "Victoria" motor, such as I referred to in the *Philosophical Magazine*, simply shunt-wound, would, if put in an electric launch, run at the same speed, whether the screw was in or out of the water. There would be no need to move the brushes and vary the number of cells or to use a regulating resistance when the load was varied, while sparking would certainly not be the cause of trouble it is in a machine with a magnetically strong armature. In fact the motor would look after itself, instead of having to receive constant attention. In all these practical matters of smoothness of running, a motor with weak armature and strong fields possesses advantages which are dearly exchanged for a slight gain in weight.

In their paper on the subject Profs. Ayrton and Perry arrived theoretically at the conclusion, that of the whole weight of a motor the armature should have 90 per cent. and the field magnets 10 per cent.; but said that their practical rule was to make the field magnets about one-quarter of the weight of the armature—a sufficient proof perhaps that the theory was not to be too implicitly relied on. They seek to show that they were right in their views as to the predominance of armatures, by drawing a comparison between an Immisch motor weighing 70 pounds, giving 1 horse-power with an efficiency of 70 per cent., and an Edison-Hopkinson machine weighing 5,208 pounds, and giving 48 horse-power with an efficiency of 92.6 per cent.

First, is there any sufficient reason to suppose that Mr. Immisch is as much indebted to Profs. Ayrton and Perry for his principles as is alleged? I think not, for this reason: A motor with a strong armature and a weak field is very sensitive as regards sparking and position of brushes to changes of load. We know, for instance, that brush movement is a distinguishing feature of the regulation of Ayrton and Perry motors. But we are told that with the Immisch motor the position of the brushes is determined and fixed once for all, and requires no further adjustment whether running on open circuit or with full load, exactly as I said in the *Philosophical Magazine*, was the case when Ayrton and Perry's principles were avoided. Unless I am very much mistaken, therefore, Mr. Immisch's case, as far as this point is concerned, is in favor of my views, and not opposed to them. How the motor is made to run on "open circuit" we are not told; the expression is probably an error—"running light" being no doubt meant.

Secondly, a weight comparison is made, based on a calculation of what an Immisch motor ought to give if of the same weight as the Edison-Hopkinson machine. Now, a calculation of this kind may prove anything, and no one can be surprised that it is made to show that the imaginary Immisch motor of the same weight as the Edison-Hopkinson machine, and of the same type as the one horse-power motor, would give 168 horse-power, or about three times that of the Edison-Hopkinson motor, with practically the same efficiency as the latter. It is more than doubtful whether the increase of output would be anything like this.

It has been mentioned, that in putting into practice a result arrived at theoretically the professors departed from that result in one case in the proportion 1 : 2.5. Apply a very similar method to the result reached in this instance, and we have

$$\frac{168}{2.5} = 67.2 \text{ H. P.}$$

And this would probably be about the correct amount; for my experience tells me that the output of motors and dynamos is, within fairly close limit, directly proportional to weight, and if this applies to any consistent series of dynamos, it must equally apply to any consistent series of motors, quite apart from the question whether I am right, or Profs. Ayrton and Perry are right, as to the proper relation which should exist between the fields and armatures of motors; whether motors should or should not be built on the same lines as dynamos, a question which will shortly be decided by the verdict of general practice.

To take the example alluded to by the professors, the weight of the one horse-power motor is given as 70 pounds, but it weighs, I understand, really 90 pounds. Let us call it 80 pounds for the sake of the average. Then if power is directly proportional to weight, the 5,208 pounds motor will give, not 168 horse-power, but

$$\frac{5208}{80} = 65 \text{ H. P.}$$

—very nearly the result arrived at in another way.

But although, in my experience at least, there is in practice no noticeable gain of weight efficiency in large dynamos and motors over small ones, there is, of course, a small gain in "commercial efficiency;" and there is also a very considerable gain in the ratio, which may be expressed:

$$\frac{\text{Watts (or H. P.) per cwt.}}{\text{Revolutions per minute.}}$$

Within the limit of ordinary sizes of machines—that is, from a few thousand watts up to 60,000 or 70,000 watts (for, unfortunately dynamos of larger sizes than these are few and far between) this ratio will be found to very nearly or quite double itself; of course this applies to both dynamos and motors.

If may be said—it certainly will be said—that the increase of this ratio in the large machines shows that they are not being worked up to their full power or speed. To this the makers would probably reply, that they are the best judges of what limits should be put to the output of their machines, and that those limits are not kept low for any but thoroughly good reasons. The competition of the various manufacturers may be relied on to keep the output of dynamos and motors up to the highest safe point.

It is fortunately not necessary that I should attempt to criticise the details of the calculation of Profs. Ayrton and Perry. It is better to compare it at once with the available results obtained in practical experiment on a commercial scale, as I have ventured to do, and in doing so to remember the words of its authors: "if a principle," or calculation, "is proved to be wrong experimentally, it must be wrong wholly and utterly."

In conclusion, let me point out that the question cannot satisfactorily be discussed in the partial way in which it has been approached by Profs. Ayrton and Perry—on the supposition that the lightest motor is the best. They would render a service to electrical engineers by examining the matter (1) on the basis of motors generally without regard to weight; or (2) for loco-motors only, taking weight into account, as well as the practical matters of working to which I have alluded.—*London Electrical Review.*

To All Electric Lighting Companies.

The following has been sent out from the office of the Executive Committee of the National Electric Light Association, at 2011 Johnston street, Philadelphia.

DEAR SIRS:—The National Electric Light Association held its first meeting in Chicago in 1884, and now has on its roll a large number of the older electric lighting companies of the country, representing all the leading systems now prominently before the public.

The meetings of the association are held semi-annually in February and August, and occupy three or four days, two sessions being held each day, at which there is a general interchange of views and discussion of subjects of great interest to all who are actively engaged in the business of electric lighting, or have capital invested therein.

If similar organizations of the older industries are necessary or advantageous as their existence and growth attest, then it is pre-eminently important that an industry so new as that of electric lighting and subject to such radical changes should have an organization prepared to discuss intelligently and practically the wonderful developments which are constantly taking place; the extraordinary demand during the last twelve months upon electricity for light and power, even at its present high cost of production, demonstrates its popularity, and it is only necessary to reduce the cost of production to make its progress more phenomenal in the future than in the past, to this end the best inventive and scientific minds are now being turned, and unless care and discretion is used, apparatus purchased this year at great cost will have to be abandoned next year and replaced by that of infinite greater efficiency.

There are no conditions under which the merits and demerits of the different systems and the various methods of operating them are more intelligently and dispassionately discussed than in the meetings of The National Electric Light Association, which has among its members not only those whose prime object is to secure an adequate return upon the capital invested, but some of the best scientific minds the country possesses.

As many new stations will probably be built during the coming year, and those already built will be extended or remodeled, it is proposed to invite plans for exhibit at the meeting in February; this, in connection with the engines, boilers, dynamos, for arc

and incandescent lighting for motors, and their relation to each other, are subjects which will be discussed at the next meeting. In view of the many schemes which are brought to the attention of investors, all of which require capital, the majority of which are visionary, but none of which can safely be ignored without investigation, it is manifestly to the interest of every one so engaged to be connected with an association so eminently qualified to discuss such matters, from both a practical and theoretical standpoint.

Further, most of the manufacturers of apparatus and of supplies in all their detail, are represented in the association. By this means buyer and seller are brought together under the most favorable circumstances.

Your company does not appear to be represented; permit us to suggest that it is to your interest to join the association and have your representative at the convention, which meets in Philadelphia, February 15, 1887.

Yours truly,

A. J. De Camp,
Chairman Executive Committee.

New Dynamo of Marcel Deprez.

Mr. Marcel Deprez, following up his studies on the electric transmission of power, which he began at first on Gramme machines, kept afterwards the winding of the ring, but obtained by altering the field magnets, types of machines really belonging to himself and exhibiting especial advantages.

The aim Mr. Deprez had in view was especially to increase the magnetic field. To attain it he used several arrangements, one of the best of which is shown in the figure. The starting point in constructing this machine was as follows: Being given a certain weight of matter, to cause the machine to absorb the greatest amount of work with the least possible heating, the speed of revolution being of course given.

This condition was carried out in the type *M D*, 10, (shown on this page.) It is, as can be seen, a machine with two rings mounted upon the same arbor. This arrangement was almost imposed on account of the use of field magnets thus constructed. For, the magnetic field is obtained by two horse-shoe electro-magnets, placed flat upon the supporting base and having the poles of contrary name one opposite the other. In this manner consequent poles, which always weaken a little the general magnetization, are avoided. The two rings are surrounded par spreading polar pieces which, being of contrary names, concentrate the lines of force in the space through which the ring crosses. The current collecting brushes are of course two in number at each end of the machine. Above the electro-magnets, Mr. Deprez had placed the screw-posts tables which are shown on the figure. Each pair corresponds to the beginning and to the end of a section of the electro-magnets. This arrangement permits to vary the groups according to the case, by connecting the screw-posts together in all possible ways. They could spend variable amounts of energy to intensify the field, and thereby use the machine for the most varied applications. The power of this machine is of about thirty horses.

It was used as a generating machine in the experiments of the Northern Railway, and also in those of Grenoble-Vizille.

In these experiments the intensity of the current generated by said machine was 2.5 amperes, and the resistance of the field magnets was 20 ohms. The amount of spent energy in the field magnets, thus hardly reached one-sixth of one horse.

Among other advantages, says *Electricité*, this machine is very steady, and does not require any important foundations on account of the base surface itself.

*** The Indianapolis *Journal* has the following pointed remark bearing on the telephone legislation of the States of Indiana and Ohio: "Simultaneous with the proposition to repeal the Indiana telephone law, a bill to enact the law has been introduced in the Ohio Legislature. If Ohio wants a law of that kind she could probably buy ours cheap."

Memorial to Indiana Legislature of Central Union Telephone Company.

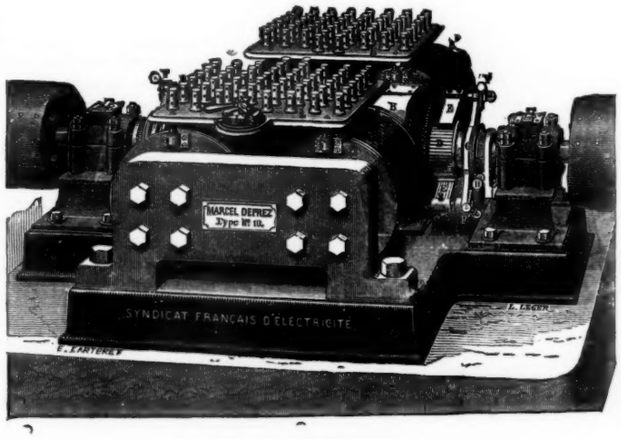
To the Honorable Members of the Senate and House of Representatives of the Indiana Legislature:

The Central Union Telephone Company respectfully present this memorial to your honorable body, and petition that you will repeal the act entitled "An Act to regulate the rental allowed for the use of telephones, and fixing a penalty for its violation," approved April 13, 1885, for the following reasons:

First. The experience for eighteen months of the practical workings of this law, in all portions of the State, has demonstrated that the interests of the public, particularly that portion of the community who desire and need telephonic service, have not been promoted by this act.

Second. The necessary and practical effect of the law has been to deprive of telephonic service many communities where it was a great convenience and value to a limited business interest, and to stop all extensions of the system in the State.

Third. Telephonic service, whether by exchanges, or by what is known as toll lines between distant points, is of such a nature that the cost is very different under different conditions, and between different points, and the benefit received is not the same; so that a rigid rule, or fixed price for all is fair neither to the company nor to the customer.



New Dynamo of Marcel Deprez.

Fourth. The law in question requires all business to be done by all the toll lines and exchanges in the State, with a few exceptions, at an actual operating loss.

When this act was passed there were in Indiana six different companies or persons operating telephone exchanges:

1. The Cumberland Company, operating exchanges at Evansville and adjoining towns, nearly all of which have been closed in consequence of the passage of the law. Evansville had an exchange of about 600 subscribers. Endeavoring to run under this law various economies were necessary, and night service was stopped, whereupon the City Council demanded its resumption. This demand not being complied with, they proceeded to cut down the poles about the exchange, thus destroying the telephonic service, not only of the company's subscribers in Evansville, but of all that portion of the State, embracing some 108 toll stations which depended upon the lines running into Evansville exchange for their only means of speedy communication with other parts of the State.

2. The exchanges at New Albany and Jeffersonville. Both were closed by this law, although some telephonic communication had since been kept up by way of Louisville, in the adjoining State.

3. The City and Suburban Company, having exchanges at Laurenceburg and Aurora. These exchanges, never profitable, have been closed since the law took effect.

4. L. Johnson, of Vincennes, operating exchanges at Vincennes, Seymour, Shelbyville and adjoining points. These exchanges have been kept open, but have not been sufficiently remunerative to justify necessary repairs on the toll lines running into them, or to provide for such renewals of plant as are necessary.

5. The superintendent of the company operating the counties of Lake and Porter reports the effect of the law upon them as follows:

"All exchange lines are closed except those at Valparaiso At Valparaiso the exchange was closed, all contracts cancelled and instruments removed Subsequently they were restored as an experiment, and toll agents were employed, with a five cent switching charge. This has proved a failure, the gross earnings from telephones being about forty cents per month. Our manager volunteered to run the thing for a time without pay; but even then it don't begin to pay expenses, and will have to be abandoned if the law stands."

6. The Central Union Telegraph Company had some thirty-nine exchanges in other parts of Indiana when this law passed. Five of these were necessarily closed by the requirements imposed; those in the five larger cities have stopped all rental of telephones and are now operated under the public station toll system. Nearly all the others have been kept along under the charges fixed by the law, and at a continued loss, and have been maintained only in the hope of a repeal of this act.

When this act passed there were 168 towns in the State, exclusive of those containing exchanges, which were connected with each other and the world at large by telephone toll lines owned by the Central Union Telephone Company. We were compelled to, and did close 105 of these stations to save ourselves from certain operating loss. The closing of these stations and lines proved a serious inconvenience and injury to a large number of citizens in the aggregate, but principally to a few important business interests, at any given point. Such places are generally without telegraphic communication, and these business interests have frequently offered to buy tickets in advance, whether used or not; and so, and otherwise to guarantee sufficient patronage to justify the operating of the lines. In such cases we have re-opened twenty-six of such stations, which would not now pay expenses without such guarantees.

When the law was passed we had over 100 applications for new telephone toll stations, the material for many of which was ordered. This law stopped all telephonic improvements and extensions in this State; nor will business prudence justify the re-building of many toll lines which have fallen down.

Before the passage of this law it was urged that a decrease of price would increase the use of our toll lines. Such has not been the result. The number of messages has not increased, and the gross receipts are very much less. Under the most prudent economy we know how to practice, the whole telephone business of the Central Union Company in the State of Indiana, including all exchanges and toll lines, for the quarter last reported, ending September 30th, shows an actual operating loss of $359.75. This is a fact without any allowance for depreciation of plant, or interest on the money invested, and represents only current cash receipts and expenses. If the repairs had been maintained as they were before the passage of the law, the loss would have been much greater.

Telephonic enterprise was, perhaps, too sanguine in establishing exchanges in more than a score of towns in Indiana, where, at former prices, the number of subscribers obtained could not make them self-sustaining; yet the Legislature cannot wish to deprive the public of these facilities, nor us of the ability of protecting our investments.

We respectfully submit that any amendment to this law is unjust that requires us, at a fixed price, to furnish something the construction and operating cost of which varies so greatly. The Legislature does not require railroads to carry a passenger from Michigan City to Jeffersonville for the same charge as for carrying him from Kokomo to Indianapolis! And, as to exchanges, if it be remembered that each subscriber must have a separate and independent wire; that some will be near by and others several miles distant; that some can have wires on poles already established, while for others new lines of poles must be built, useless for other purposes, or when such subscriber quits payment, common fairness must admit the injustice of any rigid and fixed price, and that forbids all freedom of contract which the parties are satisfied to make. We wish to give exchange lines to all who apply; but we dispute the justice of a law which compels us to build lines for parties who will not continue the use long enough to pay more than a small fraction of the expense of construction alone.

The courts have said that "if the law should prove either unjust or inexpedient, the appeal must be to the Legislature alone." We respectfully submit that a trial has shown the results of this law to be such as the Legislature did not contemplate or intend, and we therefore ask its repeal.

The Central Union Telephone Co.
By Geo. L. Phillips, President.
Indianapolis, January, 1887.

A New But Already Important Detroit Industry.

We take the following from our esteemed Detroit contemporary, the *Daily Tribune:*

The manufacture of electrical instruments did not assume anything like large proportions in this city prior to 1882. The industry has made rapid strides since that time, the volume of trade in 1886 being 50 per cent. larger than that of the previous year. One hundred and fifty skilled workmen now find employment in the manufacture of electrical goods in Detroit. The trade is influenced by three souces of demand—telephone construction, telegraph construction and general building. The past year was characterized by a universally large amount of high grade house building throughout the West and the demand for electrical furnishings stimulated the business. Telephone and telegraph construction was only fairly large. The manufacturers are generally well pleased with the present condition of trade and the prospects.

DETROIT ELECTRICAL WORKS.

This concern was incorporated in May, 1876. It now occupies large and very comfortable quarters at Seventh and Woodbridge streets. The officers of the company are: Hugh McMillan, president; W. A. Jackson, vice-president and treasurer; W. H. McKinlock, secretary; F. E. Fisher, manager. Five-sixths of the men engaged in the business in Detroit find employment with this firm. The establishment is a model of neatness and thorough equipment. Secretary McKinloch reports the outlook exceedingly bright and that the works have enough orders on hand to carry them along three months. Nearly all the apparatus used by electric lights concerns is manufactured by the Detroit electrical works, which has agents in all the large cities of the United States.

ELECTRICAL REVIEW

Published at 23 Park Row.
P. O. BOX 3329.

GEO. WORTHINGTON, - - - Editor
CHARLES W. PRICE, Associate "
LOREN N. DOWNS, President.
ANDREW J. DAM, - Vice-Pres't and Treas.
C. C. HASKINS,)
GEO. A. HAMILTON, - Consulting Electricians.
GEO. H. BENJAMIN.)

SUBSCRIPTION

United States and Canada, $3.00 per annum, in advance. Postage paid by publisher.

Great Britain and other foreign countries, $4.00, in advance. Postage paid by publisher.

ADVERTISING.

Transient, 25 cents per line, nonpareil.

EDITORIAL ANNOUNCEMENT.

Address all communications and make all Express Money orders, P. O. orders and checks, payable to order of ELECTRICAL REVIEW, P. O. Box 3329, New York.

We invite correspondence from Electricians, Inventors and the Telegraph and Telephone fraternity and those engaged in Electric Lighting on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.

We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

Subscribers can at any time have the mailing address of their paper changed by sending both old and new address.

Frank M. Gilley, 54 Equitable Building, Boston, Mass., is our New England representative.

Mr. C. C. Haskins, 118 LaSalle Street, Chicago, Ill, will represent the REVIEW in the West.

Messrs. Wm Dawson & Sons, 121 Cannon Street, London, England, are our representatives for Great Britain.

NEW YORK, FEBRUARY 5, 1887.

CONTENTS.

	PAGE
Mr. Rankin Kennedy's Dynamo	1
The Origin of Continuous-Current Transformers	1
Workshop Illumination	1
Electro motors and Their Government. By W. M. Mordey	1, 2
To all Electric Lighting Companies	2
New Dynamo of Marcel Deprez	3
Memorial to Indiana Legislature of Central Union Telephone Company	3
A New but Already Important Detroit Industry	3
Editorial Notes	4
Review of Telephone Legislation in the West	4
Chicago Electrical News	4
Boston Electrical News	5
Secondary Transformers. By Dr. G. H. Benjamin	5
To Western Electric Light Delegates	5
Telephonic News	6
Telegraph Company—Delivery of Messages—Illegal Business	6
Prof. Bell Scores a Point	6
Bell Telephone	6, 7
Prof. S. P. Thompson's Dynamo Telephones	7
Telegraphic	7
Reorganizing the Schuyler Electric Light	8
The Subject of Electric Lighting. By M. M. M. Slattery	8
Electricity the Co-servant of Gas	9
A Correction from Mr. Garratt	9
A New Incandescent Lamp	9
Electric Light News	9
Electrical Patents	10

The best informed gentleman in telephone circles, legally and scientifically, is the Hon. J. J. Storrow, of Boston. The American Bell Telephone Company secured a treasure when they engaged Mr. Storrow as general counsel.

The conclusions reached by Prof. Plympton, President of the Brooklyn Electric Subway Commission, after an extended trip over Europe, are worthy of special notice. The professor says: "The problem of construction of a telephone system on such a scale as exists in American cities with underground wires has not yet been solved abroad. In Europe no attempt has been made to solve it, because as yet there is no such general use of the telephone. The number of telephones in the United Kingdom of Great Britain, reported on January last, was 13,000, while in the United States, at the same date, there were 163,500. There are more telephones in use in New York city and Brooklyn than in all Great Britain; more in New York city alone than in all France. For the accomplishment of the ultimate object of converting our overhead electric systems of all kinds to underground systems, without impairing the efficiency of their service, without permanent injury to our streets, and without increasing the cost of the service so as to prevent the use of the same, we must depend upon the experience gained and experiments made on our own side of the Atlantic."

The meeting of the electric lighting interests at Philadelphia, February 15th, will be the strongest and most representative ever held. We are assured of this by the number of prominent workers in this field who have stated positively that they would be present.

Syracuse, N Y., is now without telephonic service, the Bell license of the American District Telegraph Company having expired. The Central New York Telephone and Telegraph Company now owns the license and will serve the subscribers as soon as an exchange can be constructed, the former company refusing to furnish service during the interim, greatly to the disappointment of the telephone patrons.

Notwithstanding the fact that General Superintendent W. H. Eckert, of the Metropolitan Telephone Company, of this city, has 6,500 telephone sets in this city to be looked after, a request from this office to have one moved to another room was complied with so promptly that within two hours the change was made and the telephone working. And it will not be amiss to say right here that the service in New York city although requiring facilities almost beyond conception, to be equal to the demand that may be made upon it from the large number of city and suburban subscribers, is not excelled in the United States.

The Senate Committee on Post Offices and Post Roads has authorized Senator Wilson, of Iowa, to report an original postal-telegraph bill as a substitute for that introduced by Senator Edmunds. The new bill is made up of the first eleven sections of that framed by the same committee in the last Congress, and reported by Senator Hill, of Colorado. These sections provide for the establishment by the Postmaster-General of a postal telegraph system by contracting for the performance of the service with the existing telegraph companies. The Government is required to furnish the offices and make provision for selling stamps to cover the charges. The schedule of rates is fixed at 20 cents for twenty words where the distance of transportation is 1,000 miles, and 5 cents for every additional 250 miles, provided that no charge for twenty words or less shall be more than 50 cents. Night rates are fixed at 15 cents for 2,000 miles or under. All words except the date are to be counted. The Postmaster-General is directed to advertise for sealed proposals to sell existing lines and franchises to the Government, and, if any of the proposals received are deemed fair and reasonable, he is required to report the same to Congress.

In a New York interview, Mr. Geo. W. Stockley, President of the Brush Electric Company, of Cleveland, says: "We have never been so busy as at present. The West and South are great fields for new plants, but the notion that the growth is entirely in that direction is erroneous. In the last three months we have placed over $100,000 worth of apparatus in the East. We are reaching out to Europe, South America, Australia, China and Japan. The original capital of our company was $100,000. It has been raised at different times until it is now $2,000,0 0; the last increase was made for the purchase of Mr. Brush's patents. He is now under contract to furnish us all his new inventions as long as the company is in existence and while he is alive. That means a good deal, for he is only a young man, much under forty years of age, and as ambitious to produce new results as when he was a struggling inventor. The latest new field of operation has been in the direction of motors, the power for which may be located at long distances away from the place of action. They require such motors in mines and the same systems can be operated upon street railroads. We have just shipped a number of motors to Denver to be used upon a street railroad. In mining, the engines which supply the power may be located a mile or two away from the place where the power is used."

REVIEW OF TELEPHONE LEGISLATION IN THE WEST.

A bill to repeal the Indiana telephone bill—the cause of so much speculation for so long a time—has been introduced into the Legislature of that State, accompanied by a memorial from the telephone people. It says that when this law was passed the following companies or persons were doing business in the State: The Cumberland, in and around Evansville, with 600 instruments, all of which have been disconnued; New Albany exchange, closed; Laurenceburg and Aurora, also. Vincennes, Seymour, and some other small exchanges, have been kept in operation under the law, but are not paying expenses. The Lake and Porter county company has ceased to transact business.

The Central Union Company, when the law was passed, had in the State thirty-nine exchanges. Five of these have been closed. The exchanges in the five largest cities of the State have been operated under a toll system, while nearly all the remaining exchanges have been kept alive under the law as a temporary arrangement, waiting in the hope of the repeal which is asked, but at a continual loss. The company has closed one hundred and five out of one hundred and sixty-eight toll line stations, and the decrease in price, instead of increasing the number of toll lines, has lessened it.

John Strecker, of the Ohio Senate, who has introduced the law in the Ohio Legislature similar to the Indiana law, has been in Indiana, canvassing the working of the law, and has returned to Columbus with a widely different view of the situation from that he had before avowed. Business men openly aver that the telephone is a business necessity, without which bankruptcy stares them in the face. Some business firms are now paying over $70 per annum on an average of four calls per day, while under the former system $52 gave them unlimited connections. The Central Union Company is losing money despite the higher charges; for under the law they can make no repairs, and if the law were repealed now, and their former legal status restored, thousands of dollars would be needed for repairs, much of which would have been saved to the company, could it have acted on the old proverb, "A stitch in time saves nine." If there were only members who naturally patronize telephone exchanges, there would be little difficulty in repealing it; but the honest granger is a chronic hater of corporations.

When the Hon. Mr. Strecker returned to Ohio with the accumulated information as to the practical working of the Indiana law, the Ohio bill met its just fate, by a vote in the House on the 27th January: Yeas, 36; nays, 51. This probably is the last of that struggle in Ohio.

But the Illinois granger Solon has not lost his grip, and proposes to regulate the telephone people in this State. A bill was introduced in the House on the 29th, "intended," says a correspondent, "to prevent discrimination between patrons of such companies. It is a short measure, and its main object seems to be to prevent charging different rates to different companies or persons."

All which means that a subscriber should not pay any more for the facilities afforded by an exchange like Chicago or New York, than for those which a little combination of a hundred or so could give. Thirty dollars per annum rental is the maximum proposed by this bill, penalties for violation being fines.

These are not uninteresting times for telephone companies, what with State legislation and the trial in the U. S. Supreme Court.

Some inventive genius has devised a means whereby the present form of wire bustles can be made useful as well as ornamental. In short, the bustle is provided with two binding posts from which leads are carried to an incandescent electric lamp on the head of the wearer. The bustle serves as a sort of secondary transformer, and it is only necessary to approach an electrical conductor to have the lamp glow brilliantly. The claim is for the combination of the girl, the bustle, and the lamp.

CHICAGO ELECTRICAL NEWS.

There is a ruction in the matter of gas bills and our city government. The assumption that there was no reduction in the bills when it was known that any number of lamps on the streets had been out of service on account of freezing for three weeks at a time, started an inquiry. This brought from the custodian of the electric light plant at the City Hall a statement on the subject that places somebody in a hole from whence a money equivalent or an explanation can only release the party accused.

Mr. McCann said: "When we shut off the gas in the City Hall, and substituted the electric light, I noticed that for two or three months the gas company charged the city with $100 per month for gas when not one foot of gas was burned in the building during that period."

As does a gas company so does a hotel. The dinner was there—if you didn't eat it, why that's your loss, and we make no deductions for absence.

The Palmer House register the other day bore the names of S. Yashima, president of the Tokio Electric Light Company, Tokio, Japan, and Ichisuke Fujioka, M. E., formerly Professor of Electrical Engineering in the Imperial College of Engineering at the same place.

These gentlemen came direct from Japan, their mission being to look into American systems of lights with a view to selecting the best for their country. They already have lights in their public buildings, but are seeking the best system for street purposes. From the United States the gentlemen will visit Germany and England on the same mission.

The latter named gentleman speaks English very well, and while in Chicago went quite generally through sample plants, and evinced a far better knowledge of systems of both generators and lamps than might have been expected. He was enabled to name all which were shown at sight. The advance made by the Japanese in what we term civilization, has never had a parallel for rapidity and thoroughness, in so short a period as has elapsed since the treaty was ratified which opened their ports to the great nations of the world.

There may be worse fire kindlers found than electric lights; at least that is what the people in Decatur, Ill., think. The Council was in session on the evening of the 26th, and a gentleman from some town in Ohio was worrying them on the subject of street lighting by gasoline. To make the illustration more perfect, all the lights, except those of the agent, were extinguished. While he was explaining the appliances for filling the tank, he loosed a screw and spilled the gasoline out of the filler. An explosion followed immediately, and the fluid was scattered over the floor. The fierce glare of light brought the outside people to the stairs, where a counter current of fleeing councilmen and lobbyists met them with the stories of the danger. This cleared the passage way, and emptied the Council chamber. Then James Hurst, chief of the Fire Department, ran up, threw the tank into a coal scuttle, carried it out, and emptied it into the street. The city records had a narrow escape, as they were lying on the burning desks.

Decatur's Solons will probably listen now to some electric light man who desires to extend the city's electric light system for them.

Copper wire will be strung for the Butte extension of the Rocky Mountain (Cairnes') telegraph as soon as the weather will permit. The wire is at Helena waiting for orders from the Weather Bureau.

The monster Kerite cable which has just been put into the new tunnel at Chicago, if it ever should get loose, and be run across by some superstitious investigator, when the present generation is gone, would make a very respectable sea serpent. The diameter

of the cable is about two inches. Within this are five cables. The gauge of these is as follows :

Two of them comprise six No. 12 copper conductors ; one No. 11 copper conductors, both B. W. G.

Two others comprise one No. 1! B. W. G. and six No. 10 B. & S. gauge. In the center or core of the cable is a fifth cable, containing six No. 17 and one No. 16 B. W. G. wires.

Two main lines will be run, each composed of a pair of the two first mentioned conductors. The center cable will be used as a shunt, when necessity requires, for ringing a fog bell by motor. The cable is 1,82) feet in length and weighs 4,000 pounds. In constructing the tunnel a slot in the side wall has been left to accommodate this huge ophidian, and the wall, after it is placed in its last resting place, will be finished so as to hide it forever. As Florence would say : Let her r-i-p, (rest in peace).

The Western Union office, at Ogden, Utah, is to be provided with Wheatstone instruments, which it is claimed have become a necessity on account of increased requirements.

CHICAGO, February 1st.

BOSTON ELECTRICAL NEWS.

About 150 gentlemen assembled in the evening of January 25th, to inspect the lately completed station of the Newton Electric Light and Power Company. In the absence of President H. B. Parker, the honors of the occasion were fi tingly done by one of the directors, Mr. A. F. Upton, general manager Jarvis Engineering Company. The station is conveniently situated on Crafts street, and is thoroughly built of wood, the foundations being placed on piles. In the rear, on the lower floor, is the boiler room, large enough for three 120 horse power boilers. One, at present, has been placed in position, furnished with Jarvis setting, Ashcroft furnace door, Nati nal heater, Korting injector, Davidson steam pump and automatic steam damper. There was a bright fire in the furnace, though the fuel was five parts coal yard dust and one part Cumberland coal. It is believed that the large proportion of cheap fuel has never before been successfully employed. The main part of the lower floor is the engine and dynamo room, containing at present one 45 Thomson-Houston arc dynamo, driven by a 60 horse-power Armington & Sims engine. The company promise to install at once a newly invented incandescent system by which thirteen 16 candle-power incandescent lamps may be economically run five miles from the station. The engine and dynamo room will contain ten engines. The prospects of the electrical railroad in Newton are favorable. The light and power company will furnish power to operate it. In front of the engine room, and to the right of the entrance, there is a convenient supply room, lighted by incandescent lamps. After inspecting the machinery, the party were invited up-stairs, where a large room, the size of the ground floor, is to be rented, with power, for manufacturing purposes. After enjoying a fine collation, the company was called to order by Mr. Upton, and the speechmaking began. A large portion of the city government were present, and expressed themselves pleased with the light, and anxious to light the whole city by means of it. It is not too much to say that this is a model station. The convenience, the ease with which the present plant may be increased, and the quality of the work, are not to be surpassed.

From present prospects the number who will represent New England at the Philadelphia meeting of the National Electric Light Association will be unusually large. Among those who have sent their names to Mr. Rid lon as intending to be represented are Brush-Swan Electric Light Company, of Burlington, Vt.; Milford Electric Light and Power Company; Superintendent Neal, of the Charle town Gas Light Company; Boston Elect ic Light Company; Sun Electric, of Woburn. The N. E. Insurance Exchange, in pursuance of a sugges ion of Mr. Frank Ridlon, at a meeting of the New York Electrical Club, will send a representative to the meeting of the National Electric Light Association.

BOSTON, Mass., Feb. 2.

SECONDARY TRANSFORMERS.

BY DR. G. H. BENJAMIN.

In the minds of all thinking men conversant with the science of electricity there now remains no question of the fact that electromotive force and quantity are the reciprocals of each other. This is not only true of voltaic currents, whether dynamically or chemically generated, but also of static currents.

Personally I am not inclined to admit that there is any difference between the so-called voltaic and static currents. The only differentiation that I have ever been able to observe, being that the potential in volts of the latter usually exceeds the electromotive force of the former.

Ga-ton Plante * in a series of experiments made for the purpose of determining what differences existed, if any, found that when the electromotive force of the voltaic arrangement employed by him equaled the po ential of the current produced by the static (frictional) apparatus used, that the manifestation of the two currents were identical, and that each was capable of being transformed into a current of greater quantity with a proportional decrease of electromotive force or potential.

Until quite recently, however, the apparatus required to effect such transformation did not exist. That is to say a device through which a current of from one thousand to five thousand volts could be transmitted, and therein transformed into a current of much smaller electromotive force and greater quantity; such, for instance, as is required to feed a number of glow lamps in parallel.

Induction coils consisting of primary and secondary helices have, it is true, been in use for many years; but in most instances the primary was of comparatively coarse wire, and the secondary of much finer wire; and hence the electromotive force of the secondary current exceeded that of the primary.

We know that the electromotive force of a current induced in the secondary, when arranged parallel with the primary conductor, depends: First, upon the distance between the conductors (decreasing, as the square of the distance), and likewise upon the resistance of the secondary; and also, that with a given current traversing a primary conductor of less resistance than the secondary conductor in proximity thereto, the electromotive force of the secondary current will exceed that of the primary.

Here we have the transformation of quantity into electromotive force. This condition is made use of in many electrical instruments, notably in the induction coils of the telephonic transmitter.

The converse of this proposition is equally true. If the resistance of the secondary b decreased below that of the primary, a corresponding decrease of electromotive force of the current in the secondary will ensue.

In the above proposition we have the theory of all so-called transformers. When we consider the practical side of the matter, the question arises, what is the loss due to transformation from quantity to electromotive force, and *vice versa*.

Unfortunately the experimental data obtainable is very meager. So far as the transformation of quantity into electromotive force is concerned, we know that the loss is considerable, which loss is due in a great measure, to the inductive influence of the currents flowing upon each other, and to self-in uction, *i.e.*, the reverse current of break, in each circuit.

The question of induction is probably the one most difficult of comprehension of any in the whole science of electricity.

In the following diagram I have tried to explain as clearly as possible the main facts connected with the subject.

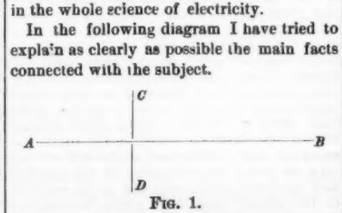


FIG. 1.

* "Recherches sur L'Electricite."

In Fig. 1, let *A B* represent a conductor on which is flowing a current of electricity, represented by the perpendicular line *C D* projected for an equal distance above and below the conductor.

In Fig. 2 the current is represented by the circle *C D* surrounding the point *A* (the conductor.) We will suppose the current to be what Prof. Sylvanus Thompson calls a magnetic whirl, and that the field of influence of the current is wholly within the circle and the direction of rotation of the whirl that indicated by the arrow.

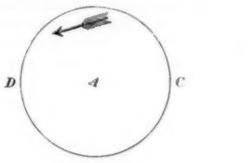


FIG. 2.

If now (Fig. 3) we arrange a second conductor *E F* parallel to *A B*, but without the field of influence of the current traversing the conductor *A B*, no current will be induced in the conductor *E F*.

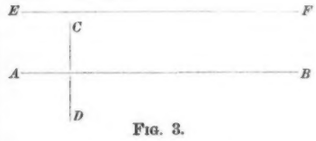


FIG. 3.

In Fig. 4 the conductor *E F* has been moved nearer to *A B*, and is within the field of influence, and we find that a current is now flowing in *E F* in the opposite direction to that flowing in *A B* (it being understood that the current of *A B* is an alternating current and that the current of *E F* reverses its direction in accordance with the alternation in direction of the current in *A B*).

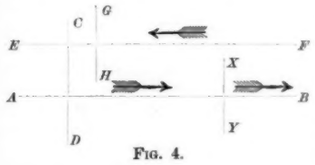


FIG. 4.

We also see that the secondary current *E F* now has its field of influence *G H* and that it mingles with the field *C D* of the primary *A B*.

Returning now to Fig. 1 the line *C D* is what I denominate the characteristic of intensity—*i.e.*, $E \times Q =$ Watts.

The length of this line or the extent of the field of influence will be found to depend upon the intensity, Watt current, flowing on the conductor, irrespective of whether the current be of high electromotive force and small quantity, or the reverse, so long as the product of the two is the same. Thus for 10 volts and 60 amperes the characteristic line will be the same as for 60 volts and 10 amperes, and this is true whether the current be continuous or alternating in character.

Hence it follows that the length of the line *G H*, subtracted from that of the line *C D*, leaves as a remainder the new line *X Y*, Fig. 4. *X Y* is, in other words, the characteristic line, representing the Watt current remaining on the line, after the current has passed through (as for instance a transformer) or away from the proximity of the secondary conductor *E F*. The sum of the Watt current in primary and secondary, is of course equal to the original Watt current on *A B*, less the loss due to heat, etc. We thus see the effects of the primary and secondary currents upon each other, when one of the conductors is within the field of influence of the current transmitted by the other. Suppose now we move the conductor *E F* nearer to *A B*, Fig. 5; we find that the current of *E F* has increased, for the reason that the inductive influence of the current in *A B* varies inversely as the square of the distance—precisely as in the case with a magnetic pole. With the conductors so placed we have, however, another condition to deal with, viz., the inductive influence of the secondary field on the primary, which follows the rule of characteristic influence as previously outlined. We have first the current in the primary, which sets up induced current in secondary, which in turn reduces current in primary, but by its inductive influence adds to current in primary—say current to 10 in primary *A B*, sets up current of 5 in secondary *E F*, which in turn sets up current of 2 in primary; resultant, a current of 7 in primary and 3 in secondary.

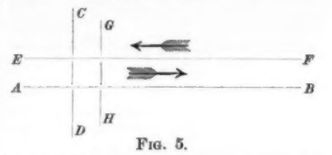


FIG. 5.

We have still one more condition to deal with, and one which it is almost impossible to either explain or calculate, viz., the self-inductive current of break or alternation. It is a well-known fact that the spark of "break" is much more intense than that of "make." How are we to explain this condition, and what relation does it bear to the inductive influence of currents traversing conductors placed as described ?

In Fig. 6 the conductors are shown arranged as in Fig. 3.

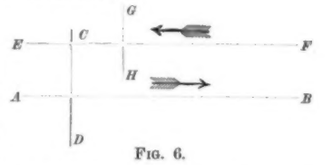


FIG. 6.

Briefly, experiment has proved that if the current in *A B* be stopped at its source, that the inertia of the moving current, (for an appreciable time) keeps it in motion, and that the current in *E F* is immediately influenced, until for an inappreciable period they are balanced, and then take the same direction adding their respective intensities.

I am not prepared to say that this is the true explanation, but my experience has demonstrated that the intensity of the current of break approximates the sum of the intensity (Watt currents) on the conductors when flowing in opposite directions.

It will be seen that the alternation in polarity of the primary current sets up reverse currents in both primary and secondary conductors, which necessarily are wasteful.

If the above conclusions, which have been deduced from experiment, be true, it is quite evident that all forms of induction apparatus wherein the primary and secondary helices are wound in close relation and the primary not shielded from the field of influence of the secondary must necessarily be more or less uneconomical.

(To be continued.)

To Western Electric Light Delegates.

ELGIN, ILL., Jan. 28, 1887.

To the Editor of Electrical Review :

SIR: I will furnish railroad tickets to parties who desire to attend the third annual meeting of the National Electric Light Association, at Philadelphia, Feb. 15th next, for $20 from Chicago to Philadelphia and return. A special Pullman car ($5 extra) reserved for delegates, will leave the Union depot, Chicago, via the Pennsylvania Railway (the finest in the world) Sunday, Feb. 13th at 3 15 P. M., arriving in Philadelphia Monday evening. All should advise me as to their wishes promptly. Any one preferring to leave Chicago on Monday can do so. I will be at the Sherman House, Chicago, Sunday morning, Feb. 13th, to arrange with those going that day. I trust a full delegation will go on in company. Ladies are always included and invited.

GEORGE S. BOWEN.

The *American Gas Light Journal* contains the following advertisement :

"Wanted:
A Good Second-Hand
Meter Prover.
Address, J—— S——
M—— Ct——"

Can this be "sarkasm "?

Telephonic News

*** Gen. Sherwin, the very capable auditor of the American Bell Telephone Company, is paying his annual visits to the leading telephone companies of the West.

*** Mr. F. R. Wells, the representative of the Western Electric Company at Antwerp, expected to return home to-day, after a pleasant sojourn of a few weeks in the United States.

*** Gen. Huidekoper, general manager of the Metropolitan Telephone Company, of this city, recently returned from a trip through the West looking into the telephone business at Chicago, Indianapolis and other points.

*** There are about 1,300 subscribers in Albany, N. Y., and every one of them is now devoting his spare time to trying the new multiple system that has just been put in. This makes it very lively at the central office.

*** Evidence of progress is seen in the instrument account of the American Bell Company for the month ended Jan. 20, as under:

Month Jan. 20.....	1886-7	1885-6	Increase.
Gross output.....	3,974	2,780	1,194
Returned	1,956	1,548	408
Net output.....	2,018	1,232	786

*** Those who have any fears that the Bell patents will be invalidated should refresh their memories by a perusal of the New Orleans decision of May 31, 1886. The case in question was decided in a stronghold of the Pan-Electric company and United States Judge Pardee and Billings held: "That in all the evidence we have found nothing that shows that Bell has done, or caused to be done, anything inconsistent with his right to be called an honest man—with clean hands. That Reis's effort to transmit speech by electricity was an acknowledged failure."

*** We publish elsewhere the memorial of the Telephone Company to the General Assembly of Indiana, asking a repeal of the telephone law. It is shown that the effect of the law has been to deprive many towns in the State of their only means of electrical communication with the outside world, and others of their only competition with the telegraph, and to cause a loss to the telephone companies. The effect in Indianapolis has been to curtail the system and the benefits derived from it, and for the good of all concerned in the use of telephones the law should be repealed.

*** The aldermen of Syracuse had a long caucus before the council meeting one night last week, and when at half-past 8 o'clock, they got ready to go up stairs, they had decided by a vote of six to two to grant the Central New York Company a telephone franchise. In the regular meeting M. J. Myers presented a communication embodying the propositions he made in an interview with a reporter of the *Journal* yesterday. Then, on motion of Alderman Candee, the new franchise was granted, Aldermen Galster and Garlick voting against it. These are the maximum telephone rates for six years, as proposed in the franchise: For business purposes—one-quarter of a mile, $48; over one-quarter and less than three-quarters, $60; and for each additional one-quarter or fraction thereof, six dollars; for residences one-half mile or under, $40; for each additional one-quarter or fraction thereof, six dollars; for residences or persons having instruments in their places of business, four dollars less than the above rates.

*** The Indianapolis *News* says: "The memorial of the Central Union telephone company to the legislature, which is printed in full in another column, is a statement which should receive serious consideration. Without discussing the question whether the operations of telephone companies should be regulated by law, and we incline to think they should, there can be no doubt that the present law has produced great annoyance and damage. It was a measure of spite work to begin with, and its only operation has been to destroy or disorganize what was once a fine service. Telephone patrons in this city every day are made aware of the fact that the service is not what it used to be, and the company assert that it can not be made such at the prices received, and that if the law is retained the service can not be improved, if indeed, it is maintained at all. There has been a great deal of unnecessary pother about this telephone matter, and it has been very easy to shriek 'monopoly.' But the practical question is, 'What is to be done?' It is apparent that the Bell monopoly, which has been sustained everywhere, has complete possession of the field and can not be reached by law. Then are we to deprive ourselves of this indispensable adjunct to business, because we are not willing to pay a fair price for its use? It is right enough to regulate the business, but it should not be attempted in a way that will destroy it."

*** The work of changing the telephone wires at Albany so as to connect them with the new switch board was finished last week. Over a thousand separate wires have been traced out, cut, gathered into cables of twenty wires each and connected with the new system. The operators had an easy time of it, however, because very few people attempted to use the telephone knowing that connections had been broken for a day. None of the employes of the company will be, as stated in the evening papers Saturday, discharged. The company needs every competent man it can get and could find work for several more. Two young lady experts from Saratoga and Cohoes, respectively, were on hand Monday, to initate the three Albany girls, who have been engaged, into the workings of the new system. The wires are also being changed in the branch office on Washington avenue. Within a month or two the whole plant will be gathered at the main office and the branch will be discontinued. It is possible that some of the young men at present employed as operatives may be discharged and girls taken in their places. The work is light and not uninteresting, and can be readily and satisfactorily performed by women. The girls will be expected to do night as well as day duty, taking their turn regularly, as do the male operatives. One of the chief advantages of the new system is that the operator does not break in with the sheolish query, "Are you through?" He knows when the speaker is through, because the latter will give the telephone handle a half turn to convey that information. The power for the generator will be obtained from the electric light works. It is now furnished by the *Argus* company. The new system bids fair to give universal satisfaction. The efforts of the company to make it a success should be recognized by citizens generally, and every endeavor made to secure a valuable service. The Western electric multiple boards were the ones put in, and Mr. Frank Harrington, of the Western Electric Company, was present to see that everything went off well, and it did.

Telegraph Company—Delivery of Messages—Illegal Business.

A telegraph company cannot be required to communicate a message which is to furnish the means of carrying on an illegal business, whatever its motive in refusing to communicate the message, according to the decision of the Kentucky Court of Appeals in the case of Smith *vs.* Western Union Telegraph Company. In this case the court refused to require the appellee to continue to furnish the appellant, the keeper of a "bucket shop," with the market quotations, the court taking the view that the "bucket shop" dealings were a species of gambling, and therefore illegal and contrary to public policy.

Prof. Bell Scores a Point.

HIS COUNSEL EXPLAINS THE INTERLINEATED COPY OF THE SPECIFICATIONS, AND MAKES A SENSATION IN THE UNITED STATES SUPREME COURT.

WASHINGTON, Jan. 27.—The United States Supreme Court room was crowded this morning when the court reassembled to continue the hearing of argument in the telephone cases, it having been generally understood that Mr. Lysander Hill, who began speaking yesterday for the Overland and People's companies, would present this morning the charges of fraud in the procurement of the Bell patent which are contained in his printed brief.

Mr. Hill began by asserting that Prof. Bell had changed the specifications of his patent while his application was pending. He maintained that in February, 1876, after Prof. Bell had filed his application for a new patent, he surreptitiously obtained, through Examiner Wilbur's room in the Patent Office, information with regard to the contents of a caveat filed by Prof. Elisha Gray to protect a telephonic process invented by him; that Prof. Bell availed himself of the knowledge thus obtained to amend and widen his own specifications so as to include many of the features of Prof. Gray's invention. As proof of such fraudulent interpolation, Mr. Hill referred to two documents, one a copy of Prof Bell's specifications, which was given in January, 1876, to George Brown to be taken to England for the purpose of obtaining a patent there; and the other a certified copy of the interlined and interpolated specifications which had at one time been on file in the Patent Office, but which, he said, Prof. Bell, or his attorneys, by collusion with the employes of the Patent Office, had subsequently removed and destroyed, to conceal the fraudulent interpolations, substituting a clean copy, in which the interlineations had been incorporated.

Mr. Hill's charges of fraud rested mainly upon the interpolated and interlined transcript of the Bell specifications which had been obtained from the Patent Office in 1879, and used as an exhibit in the Dowd case in the United States Circuit Court for the District of Massachusetts. This transcript, he said, was a copy of the Bell specifications as they were then on file in the Patent Office, and was certified as correct by the Commissioner of Patents. It contained thirty-nine changes and interlineations, which, Mr. Hill said, "correspond so curiously to the George Brown copy as to leave no room for doubt that the original Patent Office specifications corresponded with the George Brown copy entirely."

Every eye was on Mr. Storrow when he rose to reply. Mr. Storrow first argued that such changes as had been made in Professor Bell's specifications after the George Brown copy had been sent to England were changes which he had a perfect legal right to make; that they were made in due time, and that they had no relation whatever to the Gray caveat, but were the results of Professor Bell's independent thinking. He said he could explain to the court in a few words the origin of the so-called changes, interlineations and interpolations upon the strength of which Bell had been charged with bribery, perjury and falsifications. He said:

When I was preparing for the argument in the Dowd case, which was pending in the United States Court for the District of Massachusetts, it became necessary for me to compare the specifications contained in Prof. Bell's application for a patent, with the specifications sent to England by George Brown for the purpose of obtaining a patent in that country. I sent to the Patent Office and obtained a certified copy of the Bell specifications in the form in which they then were and always have been on file there. I began comparing this certified copy with the George Brown specifications, and for my own convenience I noted down and interlined in pencil on the certified copy the variations from it which I found in the George Brown specfications which were earlier in point of time. Afterward it became necessary to put a certified copy of the original Bell specifications in evidence as an exhibit in the Dowd case, and I put in this pencil-marked, annotated and interlined copy without thinking to erase the pencil marks. The compositor set it up and it was printed exactly in the shape in which it stood, pencil marks and all, the penciled variations taken from the George Brown copy being put in brackets or otherwise disposed of according to the printer's discretion. The document thus stands in the record of the Dowd case which has been incorporated in the record of one of the other cases. I, therefore, made myself, and for my own convenience, the changes, interlineations, and interpolations in this document which have been used by council on the other side to support the charge of fraud. The original specifications now on file in the Patent Office are the same which have always been there, and, as your Honors will see from a certified photographic copy which I now submit, there are no changes or interlineations in them.

This announcement produced a profound sensation in the court room.

Mr. Storrow then said that the Clerk of the Circuit Court for the District of Massachusetts was present with the original document in question, and that he should ask that officer to present it to this Court as proof of his statements, and to show that the interlineations were in pencil and in his (Mr. Storrow's) hand-writing.

The Chief Justice said that he thought all this was inadmissible; that it was bringing into this court something which did not appear in the records, and that this court could not examine witnesses nor hear evidence.

Mr. Storrow said he held in his hand a stipulation, entered into by counsel for both sides, that if this court so desired it might call for and examine all of the original documents in the court below, or the original Bell specifications, to verify the accuracy of alleged copies.

The stipulated and accompanying letter were handed to the Chief Justice, who read them aloud. It had been entered into long before, and without any reference to such an application of it as this, but it proved to be the thing needed at this critical moment to enable the Bell counsel to get the pencil-interlined document, which was so important a part of the cases, into the hands of court.

The Chief Justice asked Mr. Hill if he understood the stipulation as did Mr. Storrow. Mr. Hill replied that he did not. The justices, however, after a few moments' consultation, decided that the stipulation was sufficient to authorize the court to call for the documeuts, and the Chief Justice directed Mr. Stetson, the gray-haired clerk of the Massachusetts Circuit Court, to present it. Amid profound silence Mr. Stetson advanced, untied a brown paper packet and handed a bulky document to Chief Justice Waite, who said that the court would examine and make comparisons for itself.

Thus ended what disinterested members of the bar regard as one of the hottest and most brilliant legal skirmishes which has recently taken place within the walls of this court. The prevailing impression seemed to be that the charges of fraud had been greatly shaken if not overthrown, and that counsel for the Bell Company had scored a point. Mr. Storrow continued his argument until the court adjourned at 4 o'clock, but confinded himself to the merits of the case without any further reference to the alleged frauds.

Bell Telephone Cases.

A CONCISE STATEMENT OF THE PENDING LITIGATION.

The arguments which are being delivered before the Supreme Court at Washington will be most notable in the history of telephone litigation, and it will be of interest to those having only a popular knowledge of the subject to view the following concise status of the cases which will come before the court.

There are now pending upon the docket of this court appeals in five cases involving the validity of the Bell telephone patents of March 10, 1876, and Jan. 30, 1877. These are: The Dolbear, No. 113, from district of Massachusetts, and the Molecular, Nos. 667 and 668 (one being a cross-appeal brought by the Bell company); the Clay, No. 1,092; the

People's, No. 1,164 (known as the Drawbaugh), and the Overland, No. 1,165, all from the southern district of New York, which is in reality three cases in one, from the southern district of New York, the district of New Jersey, and the eastern district of Pennsylvania, respectively. These five appeals are understood to contain every substantial defence that has been made to the Bell patents, and every word of evidence that has been given to support them, and they may be briefly classified an follows:

First.—The claim that the Reis instrument was a perfect operative telephone, acting upon the microphonic principle, and therefore a full and complete anticipation of the Bell patents.

Second.—That the Reis instrument, while not a perfect operative speaking telephone, yet was an instrument designed for and capable of transmitting by electricity mu-ical tones at least, and, as such, defining the state of the art, and, therefore, limiting Bell's claims to the instrument shown in the patent alone.

Third.—That the instruments described in the Bell patents are inoperative as a speaking telephone, and that, therefore, his patent, so far as it is said to cover a telephone, is void.

Fourth —That Bell got his patent by fraud (this refers to the Gray matter, etc.) and that it is therefore void.

Fifth.—That the principle sought to be covered is not patentable, and that the patent would therefore be limited to the device shown.

Sixth.—That the instruments made by Drawbaugh were in existence before March 10, 1876, and were therefore an anticipation.

Seventh.—The Dolbear defence, which is special to itself, admits the validity of the Bell patent, but claims that Dolbear's machine works on a different principle and therefore does not infringe.

The counsel, who will probably take part in the argument of these appeals, are: Causten Browne and J. E. Maynadier, of Boston, for the Dolbear Company; Wheeler H. Peckham and Grosvenor P. Lowery, of New York, for the Molecular; Furman Shepard, of Philadelphia, for the Clay; Senator George F. Edmunds, of Vermont; Lysander Hill, of Chicago, and Don M. Dickinson, of Detroit, for the Overland and Drawbaugh cases; and E. N. Dickinson, of New York, and J. J. Storrow and Chauncey Smith, of Boston, for the Bell.

It is to be observed that all the defences mentioned above, except one, are available only against the first patent of Bell, that of March 10, 1876 and that this patent might be broken by the Supreme Court, and yet the second patent being sustained, the field would still be clo-ed. The second patent of Bell, of Jan. 30, 1877, has never been assailed, and, it being for simply forms of instruments, nearly all of which are in universal use to-day, the field of telephony would still be covered by the Bell Company. There is one defence, however, t at of Drawbaugh, which is claimed to be an answer to this second patent also; and if the Supreme Court should find that Drawbaugh and his "cloud of corroborative witnesses" have told the truth, and that Drawbaugh's magneto instruments *D* and *E*, which contain all the elements of Bell's second patent, were in existence at the time stated by them, then both barriers will be broken down.

The Government suit (known as the Pan-Electric suit) contains no material points not included in the records, although the Government counsel claim that some of them have not been as effectively presented as they could have been.

....The report of the commissioners appointed on capital punishment by Governor Hill, will be based upon the answers received to the circular issued by them quite generally, with a view to obtain a general expression of sentiment regarding the advisability of the present mode of inflicting capital punishment, or of one of the four following substitutes: electricity, poison, the guillotine, the garrote. A large number of replies have been received and filed, and Dr. Southwick said last week that the weight of opinions expressed was against hanging, and in favor of a less objectionable method of inflicting capital punishment, and that the majority sentiment advocated electricity as a substitute. The report of the Commission would, therefore, be in favor of the adoption of some electrical apparatus for execution.

Prof. S. P. Thompson's Dynamo Telephones.

A method of making more powerful telephones than those of the well-known type has, says the *English Mechanic*, been recently patented by Prof. Silvanus P. Thompson, who describes his invention as consisting of dynamo telephones which will serve either as transmitting or receiving instruments of great power. It is well known that any dynamo-electric or magneto electric machine will serve either as a generator of currents or as a motor. In such machines there are usually two distinct parts respectively called the field magnet and the armature; the relative motion of one or both of those organs generate currents, or if currents from an external source traverse the armature, mechanical motion results. And in such machines it is usual to make the field magnet a very powerful magnet (either permanent or temporary) having great magnetic inertia and the armature of small magnetic inertia and relatively light.

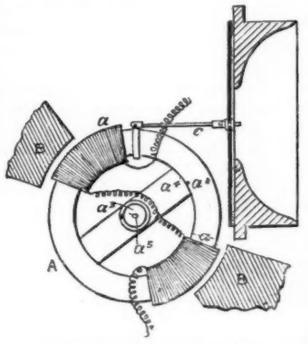
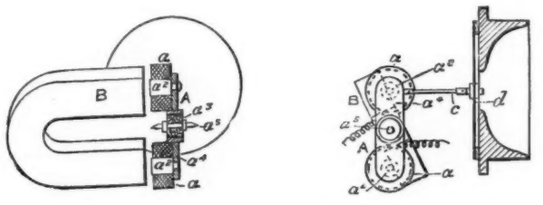


FIGURE 3—THOMPSON'S DYNAMO TELEPHONE. SHOWING RING ARMATURE.



FIGURES 1 AND 2—SYLVANUS P. THOMPSON'S DYNAMO TELEPHONE.

The improved telephones act on the same principal as that on which dynamo-electric machines (including magneto-electric in that term) of any one of the known types act; but Prof. Thompson makes the armature, or some part thereof, capable of vibration instead of the usual rotation on an axle, these vibrations being communicated either from the armature to the listener's ear or from the speaker's mouth to the armature by suitable mechanism or mechanisms or simply by the intervening air. The form of the armature may be any of the well-known patterns—such as the Gramme ring, the Siemens drum, or other form—but he prefers in some cases to modify and simplify the manner of grouping or connecting the coils. The commatator common in dynamo-electric machines is not used. It is of advantage that the coils of the armature should be so grouped that they occupy the position where the magnetic field is strongest, so that any small motion given to them may have the greatest induction effect in transmitting or receiving, and so that any small current traversing the coils may produce the most powerful effect in receiving the coils of the armature, which may be of fine, well-insulated copper wire, are connected in the line circuit. The coils on the field magnets (if any) may be arranged either in a local circuit or in line or as shunt to the coils. It is advantageous to laminate the cores both of the armatures and of the field magnets. When the armature is pivoted on or about an axis, a cushion or sleeve of elastic matter may be applied at the said parts or axis. When the armature or its core is mounted on a spring, the spring may be either straight or coiled, or, instead of a spring or cushion, a mass of yielding material may be substituted. Internal magnets or electro-magnets may be placed within the armature to reinforce the magnetic field, thus enabling the self-induction and resistance of the armature coils to be reduced.

Figs. 1 and 2 of the accompanying drawings show in views at right angles to each other a dynamo telephone on the magneto principle, the armature *A* being mounted to vibrate (on the pivot a^5 mounted in any suitable supports) in front of the poles of a permanent magnet *B*. There are two coils *a*, on the iron cores a^2, carried by an iron yoke a^4, mounted on an elastic hub a^3, and suitably pivoted. A short and light stiff connecting rod *c* makes the necessary communication between the armature and the diaphragm *d*. It is found desirable in setting up the instrument to give to the armature a slight lead with respect to the field-magnets. This has double effect, it causes any small change in position to have a greater influence on the magnetic field, and it also gives a mechanico-magnetic back attraction which serves to keep the diaphragm in a state of initial tension. The diaphragm may be of mica, celluloid, parchment, aluminium, or any metal, whether magnetic or not, its functions being purely acoustic. Fig. 3 shows a ring armature, resembling that of the well-known Gramme dynamo, but having coils grouped in two sets only, connected in series (or parallel, if desired, for low resistance). The ring is pivoted as before described and connected to the diaphragm as shown, and corresponding parts to those shown in Figs. 1 and 2 are marked with the same letters of reference. The ring may be made with protruding teeth, as in the Pacinotti dynamo. The patentee does not limit the invention to the precise details described in his specification, for they can be varied without departing from the nature of the invention: for example, the armature may be a a soft iron piece without coils, mounted and connected as described in proxmity to the poles of an electro-magnet.

The Telephone.

The following is from the New York *Sun*:

"One of the most memorable gatherings of lawyers ever collected in Washington is now before the Supreme Court to argue concerning the validity of the telephone patents. All the points ever raised in the various contests over this subject are presented in the voluminous books of the many cases, and will be discussed by the different counsel and finally decided by the Court. There will be a conclusive decision whether Bell should have the patent or whether Gray should have it; whether Bell cheated Gray or whether he didn't; or whether or not the modern telephone was invented long ago by Philip Reis, making it impossible for any one to patent it. Not a single question yet raised in this great controversy will fail of due discussion and consideration, and then they will be settled finally for good and all. Every individual right and every public right in dispute regarding the telephone will be examined and determined.

But a knowledge that this must happen was not sufficient to prevent the President of the United States from being bamboozled by Pan-Electric speculators into furnishing them, in the name of the United States and at its expense, with a force of counsel to contest these same disputed questions, with the hope of overawing the courts. Some of the counsel now engaged before the Supreme Court in behalf of one or the other of the interested parties, have been retained by the Executive to argue the same points for the benefit of the Pan-Electric Company.

We trust that after the simple-minded Grover Cleveland's term, such a disgraceful spectable as this may never be seen again. Public office as it is now would appear in earnest to be a Pan-Electric trust.

TELEGRAPHIC

The Electric Song.

To the Editor of Electrical Review:

Beware, feeble man, of my power erratic,
And tremble before my mysterious presence;
Bow downward and adore with loud praises ecstatic
My wondrous, unmeasured, ethereal essence.

Brought forth of the cyclone, the son of the sunstorm,
The father of both, the creator of motion,
From your sun (and its seething to me is but lukewarm),
I flash through the depths of an infinite ocean.

To me time is nothing and space but a plaything;
I sport with the Nebulæ, th' sweet sisters woo;
At once in the north I can copy the day spring,
And revel with comets far out on the blue.

Dread dealer of death, and of life the sweet giver,
Why fear ye not creatures, with awe and with wonder?
Saw ye not my fierce lightning the forest king shiver?
Heard ye not from the clouds the dread voice of my thunder?

But, alas! though you never will fathom my nature,
Though my coming and going you cannot control,
You have tabled my power with absurd nomenclature,
And evolved from your drugs my mysterious soul.

But use, if you will, my wandering forces,
And float on my current to glory and fame;
I'll still run unhampered through infinite courses;
You'll comprehend nothing of me but my name.

NEWARK, N. J. EDWARD HOBART CRAIG.

.... Lincoln, Neb., is arranging for a new electric fire alarm.

.... Nothing is left to prevent the Western Union from continuing its connection in Canada with the Dominion Company, the capital of which is $1,000,000, some $400,000 of which is hold by Jay Gould, thus leaving the Montreal Company to paddle its own canoe. A telegraph man states that it is within his personal knowledge that the property of the company has been allowed to deteriorate, and that the property is not in nearly as good condition as when handed over to the Great Northwestern Company in 1881.

.... The telegraphers of the Lake Shore and Michigan Southern Railway, held their annual ball in Erie, Pa., January 25. The ball-room was magnificently decorated for the occasion, the hangings even exceeding in beauty those of a year ago. There was in each corner of the room a small booth fitted up with telegraph instruments, telephones and all electric appliances, while over the center of the stage at the upper end of the hall hung two arc lights, which illuminated the ball-room. The evening trains arriving in the city came loaded with young men and ladies to attend the ball.

. . . The annual meeting of the Montreal Telegraph Company was held in Montreal, last Tuesday, the president, Andrew Allan, in the chair, when the annual report was submitted and adopted. At the request of the president, Thos. Workman moved a motion which was carried, authorizing the incoming directors to take such steps as they deemed right for the enforcement of the agreement with the G. N. W. Company of the 17th August, 1881. Some discussion took place, in which some of those present called the G. N. W. Company to account for alleged bad service. Some of the shareholders present attempted to shoulder the responsibility of the agreement of 1881 on the then directors; but it was shown that the directors of that time were opposed to the amalgamation, and that the shareholders were alone responsible for it. Thomas Workman said it had been stated in the street that the dividend would arrive in a day or two; but the president replied that he knew nothing of it. The following directors were elected: Andrew Allan, Hector Mackenzie, Wm. Cassils, Jesse, Joseph and Wm. Wainwright, the two latter replacing John Crawford and John Sterling. Andrew Allan was re-elected president.

The Phonoplex System.

SIMULTANEOUS TRANSMISSION OF TELEGRAPHIC AND TELEPHONIC CURRENTS OVER THE SAME WIRE.

An interesting lecture on "The Simultaneous Transmission of Telegraphic and Telephonic Currents Over the Same Wire" was delivered last week before the Buffalo Electrical Society, by Frank Kitton, of the Western Union. This system, he said, was of great importance, as it attained new results by methods and devices essentially new. The fundamental object of the system was to remove the cause of induction, rather than to counteract the induction itself, and this is accomplished by means of condensers, which play as important a role in this system as in the duplex or quadruplex systems. Experiments made some time ago by Van Rysselberghe, of Belgium, established the fact that both Morse and telephone signals could be transmitted at the same time over a single wire, by graduating the telegraphic signals so as not to affect the telephone, and by bridging the telegraph apparatus so as to afford a path for the telephone currents when the wire is opened by the operation of the Morse key. The "graduators" consist of extra electro-magnets placed in the circuit, for the purpose of gradually increasing and decreasing the strength of telegraph signals which then merely bend the telephone diaphragm, without causing it to emit any sound. The continuity of the circuit for telephonic sounds is preserved by placing around the Morse instruments a condenser through which the "phone" currents act by induction. The telephones themselves are connected with the main line by branch wires, a condenser being inserted between the main line and each telephone. In this way the currents sent by the telegraph key are rendered inoperative on the telephone receiver, while the telephone currents are too feeble to affect the Morse apparatus.

After giving an interesting account of the experiments which led to these discoveries by Van Rysselberghe, the lecturer pointed out that George Black, the present manager of the Great Northwestern Telegraph Company, at Hamilton Ont., had experimented in the same direction and with considerable success several years prior to the announcement of Van Rysselberghe's discoveries. A patent was issued to Mr. Black and Dr. Roseburg of Toronto for a system af telephoning and telegraphing over the same wire, in February, 1879, and the system was applied on several district telegraph lines in various cities; but the requirements of the service did not then warrant its general adption. It has since been operated, however, with perfect success over the Great Northwestern telegraph wires.

Edison's phonoplex system of simultaneous transmission, is an ingenious application of the principle described, and is in operation over many of the Canadian lines, as well as between this city and Toronto. It differs from the Rysselberghe system only in the method of operating the telephone, which is not used for the reception of sound vibrations but acts like an ordinary telegraph sounder in responding to Morse signalling. The currents employed in its operation are the "extra currents" of a spark coil, the characteristics of which are those of high potential and great rapidity. Mr. Kitton entered into a detailed statement of the nature of these currents and the part played by the condensers in obviating induction and other disturbances, and then spoke of the particular applicability of this system to railroad telegraph lines. The phonoplex, he said, doubles the capacity of a wire with any or all of the immediate points, and is capable of establishing a number of shorter independent circuits on a through line, without in any disturbing its usual working as a "way" circuit from terminal to terminal. In addition, it is not so susceptible to weather changes, and practically works as well in wet weather as in dry. It is not at the mercy of the careless operator who leaves his key open, either on the Morse or 'phone circuit, and only an actual disconnection of the wire renders it useless. This fact alone would seem to recommend it strongly on important way and railroad circuits, where business or trains are frequently delayed as the result of some office leaving the circuit open.

The lecturer concluded by stating that the discovery of the various systems described had opened up a new and extensive prospective field in multiple transmission, and that already Stephen D. Field of New York had combined quadruplex and phonoplex working in such a manner as to attain sextuple working over a single wire.

Instruction in Electrical Engineering at the Massachusetts Institute of Technology, Boston, Mass.

As a foundation for subsequent work, thorough instruction is given in the theory of electricity. An extended course of lectures is devoted to the consideration of the various technical applications of electricity to land and submarine telegraphy, the telephone, electric lighting, and the electrical transmission of power. Instruction is given by lectures and laboratory exercises upon the processes of photometry, especially as applied to the measurement of electric lights. Advanced instruction in electrical measurements, including work with dynamo-electric machinery, together with a course on the electrical testing of telegraph lines, is provided. The subjects of construction, specifications, and contracts also receive attention.

In the latter part of the course, each student prepares and reads before his class an essay on some electrical process, instrument, or system, or other professional topic. These are written after a study of recently published papers and memoirs, and often embody also the results of experimental work by the student. They are intended to familiarize the class with the topics presented and to give experience in independent study, and in the preparation of original scientific papers. The work is also of particular advantage to those who intend to become teachers.

Besides the work done by the regular staff of instruction of the Institute, special teaching will be given by gentlemen who are professionally engaged in various departments of electrical engineering, or especially conversant with certain branches of applied electricity. During the past year such instruction has been given by the following gentlemen:

Mr. George W. Blodgett, electrician of the Boston and Albany railroad, on the application of electricity to railway signalling; Mr. J. Rayner Edmands, of the Harvard College Observatory on the establishment and distribution of time; Mr. C. G. H. Woodbury, of the Manufacturers' Mutual Fire Insurance Company, on electric lighting in its relation to fires and fire insurance; Mr. C. A. George, on municipal fire alarm systems. It is expected that these courses will be still further extended during the current year.

The Institute has received from the Union Electric Switch and Signal Company the valuable gift of a complete set of its electric railway signals, and is also indebted to the Brush Electric Company for the loan of a dynamo-electric machine, and a storage battery, together with electric lamps of several patterns. A Weston 60 light incandescent dynamo machine, a Gramme machine, and a compound dynamo for experimental purposes have recently been added to the apparatus available for instruction in this department. It has also received from the Edison Electric Light Company an illustrative set of incandescent lamps, switches, cut-outs, and other devices.

This course has been established in order to meet the wants of young men desirous of entering upon the practice of any of the various applications of electricity in the arts. Its leading studies are physics, especially theoretical and applied electricity, mathematics, and mechanical engineering.

A broad training is obtained by the introduction of full mathematical courses, and studies in history, literature, political economy, and French and German, the latter being of importance in obtaining at first hands a prompt acquaintance with invention and discovery. Of the technical studies of the course, those in mechanical engineering run parallel with the electrical subjects, since in many branches of electrical engineering a sound knowledge of mechanics, motors, of measurements of power and its transmission, etc., is essential. Thus, through the second year the students follow mathematics, mechanism, shopwork, and drawing, to about the same extent as those of the mechanical engineering course. In the third year the pure and applied mathematics, mechanics, and mechanical engineering (lecture and laboratory work) are much the same in the two courses; and certain of these subjects are continued in the fourth year.

A full course in physics begins with the second year and continues, by lectures, recitations, and laboratory work, to the end of the third year. A portion of this is devoted to electricity; and at the middle of the second year, special readings and recitations on this topic are begun, by which the study of the theory of electricity is continued until the end of the third year. Work in the physical laboratory commences at the middle of the second year, and leads up to electrical measurements and testing. In the fourth year are given extended courses on the technical application of electricity to the telegraph, telephone, electric light, etc. Electrical study and research occupy the principal position in the fourth year. A series of advanced mathematical topics is also an important part of the work of this year:

FIRST YEAR.—Same for all courses.

SECOND YEAR.

FIRST TERM.	SECOND TERM.
Physics: Lectures.	Physics: Lectures.
Mechanics and Acoustics.	Physical Laboratory.
Analytic Geometry.	Acoustics and Electricity.
Descriptive Geometry.	Differential Calculus.
Mechanism	Mechanism.
Carpentry and Wood-turning	Drawing.
Political Economy.	Metal Turning.
German.	Literature.
	German.

THIRD YEAR.

FIRST TERM.	SECOND YEAR.
Physics: Lectures and Laboratory.	Physical Lab.: Heat, Electricity.
Electricity: Readings.	Electricity: Readings.
Integral Calculus.	Kinematics and Dynamics.
General Statics.	Strength of Materials.
Mechanical Engineering	Mechanical Engineering
Drawing.	Mech. Engineering Laboratory.
Literature.	Drawing.
German.	Literature.
	German.

FOURTH YEAR.

FIRST TERM.	SECOND TERM.
Technical Applications of Electricity to Telegraph, Telephone, Elect. Lighting, etc.: Lectures.	Technical Applications of Electricity.
Phys. Lab: Electrical Testing and Construction of Instruments.	Advanced Physics, Memoirs, etc.
Testing of Telegraph Lines, Dynamo Machines, etc.	Physical Research.
Advanced Physics: Memoirs, etc.	Differential Equations.
Photometry.	Calculus of Variations.
Method of Least Squares	Mech. Engineering Laboratory.
Mechanical Engineering	Discussion of the Precision of Measurements.
Mech. Engineering Laboratory.	*Options.*
Applied Mechanics, Thermodynamics, Hydraulics, etc.	1. Quaternions.
	2. Physical Laboratory.
	3. Theory of Potential.

NOTE.—The student is advised to take Advanced German.

* * A man who imagined himself a telephone, and who has been trying for a year to shout "hello!" in his own ear, has been sent to an asylum at Flatbush, L. I.

* * On the evening of September 11, 1886, George Christian was sitting on the gallery or balcony of his boarding house, in New Orleans. A breeze was blowing with enough power to throw the wires of the Louisiana Electric Light and Power Company against the railing of the gallery upon which Christian's hands were resting. The wires also touched his hands and he was severely shocked, being thrown from his chair. He asks for $1,680 damages, alleging carelessness on the part of the company in stringing its wires with a slack sufficient to allow of their being blown against the gallery.

The Police and the Subways.

The Corporation Counsel sent the following letter to the Police Board last week, which will be of interest in relation to the underground wire question in this city:

NEW YORK, January 25, 1887.

William H. Kipp, Esq., Chief Clerk of the Board of Police:

SIR: Your communication of December 3, 1886, enclosing communication from John R. Dos Passos, Esq., and William H. Johnston, Esq., general manager of the New York Underground Telegraph Company, relative to interference with the employes of such company by the police, was duly received. You state that the Board asks my opinion as to the duty of the Police Department in the premises. The communication has not been answered before for reasons hereinafter explained.

It is provided by Chapter 499 of the Laws of 1885 (section 3) that before any conduits, in which are to be placed underground electrical conductors shall be constructed, the company authorized to construct such conduits must file certain maps with the Commissioners of Electrical Subways and must obtain the approval of said Commissioners of the plan of construction proposed by such company. The construction of such conduits without such approval is, therefore, an act prohibited by statute, and under section 155 of the Penal Code (referred to in my former communication to you under date of September 17, 1886), the doing of such act is a misdemeanor, for the commission of which in the presence of a police officer he is authorized to arrest the offender.

Immediately upon the receipt of your communication and before a reply could be sent, an action in equity was begun by the Board of Commissioners of Electrical Subways against the New York Underground Telegraph Company, which necessarily involved the discussion and interpretation of the statute above cited (chap. 499 of 1885) and also a question which was raised by said company as to the constitutionality of the law.

Pending the discussion of these questions before the court, and its consideration and decision thereof, it seemed proper that the reply to your letter should be delayed. The court (Van Hoesen, J.) yesterday handed down the decision upon the application for injunction made in the suit above referred to. The judge denies the application for an injunction to restrain the New York Underground Telegraph Company from laying any wires in the streets, excepting through the conduit which has been constructed by the Commissioners of Electrical Subways. He does not, however, sustain the contention that the act is unconstitutional. He expressly holds, also, that under its terms the Commissioners of Electrical Subways were to approve the plans to be submitted, and that all the companies operating electrical wires are to be compelled to place them in subways built in conformity with the plan so selected or approved.

I therefore advise you that, in my opinion, the New York Underground Telegraph Company are prohibited by statute from constructing subterranean conduits for electrical conductors, until they shall have first submitted a plan to the Commissioners of the Electrical Subways, and shall have secured the approval of such plan.

I am, Sir, yours respectfully,

E. HENRY LACOMBE,
Counsel to the Corporation.

* * The German army possesses a new explosive called "roburite." It is said to be more powerful than "melanite," the new explosive approved by the French Minister of War for military usage, as mentioned in our last issue, and can only be exploded by intense heat.

* * At the annual meeting of the Mount Adams and Eden Park Railway Company, Cincinnati, held last week, the most important business done was the decision to make the Oak street line, that is, the line from the cable on McMillan street to the Reading road, an electric road. The change will be made at once.

Electricity the Co-Servant of Gas.

Mr. Charles F. Spaulding, of Brookline, Mass., in a paper on "Electric Lighting," recently read before the American Gas Light Association, very pertinently said:

"We were, as you know, inclined to look upon the electric light as a temporary affair, or a 'clothes-line' sort of arrangement which would soon die a natural death, and thus leave us a clear field. That we were mistaken needs no argument of mine to prove. The electric light came, was welcomed, and will remain with us. We ought to look upon its permanency as an acknowledged fact, and endeavor to frame methods by which we shall be able to prevent a ruinous competition. How shall this be done? By fighting the inevitable, or by making the electric light a co-servant of gas? Surely you will say the latter; and the result of my own experience in the electric lighting field during the past two years would endorse the wisdom of that decision.

"Now, gentlemen, it is presumed that we meet here as partners in a common cause; we are interested in the gas business because of the profits to be derived therefrom, and not as philanthropists. If we are doing a satisfactory business, why not take such measures as will insure its continuing so? And if we are doing a losing business, why not embrace any chance that may offer to improve it? My advice to those in charge of any gas lighting company, whether prosperous or otherwise, would be to prepare to do both kinds of lighting—electric and gas—and thus best serve the public; for it is from the public we must look for support."

A Correction from Mr. Garratt.

To the Editor of Electrical Review:

I see in your issue of January 15, that I am reported as having made certain statements at the last meeting of The Electric Club of New York, which certainly do not convey the idea which I intended to give. Perhaps I did not express myself clearly, or possibly the stenographer did not report me correctly. At all events the statements as published are misleading.

I am reported as saying that an alternating current of comparatively low potential would terminate in a fire where a direct current might not do so. I do not believe this to be so. It would be misleading to make any such sweeping statement even if there was any very great danger of fire from a low potential alternating current, which I do not know to be the case. I am also reported as saying that I would willingly take through my hands a direct current of a 1000 volts potential. What I did say was this: I have heard of persons taking a current of a 1000 volts, and I would myself willingly take through my hands a current of 500 volts, and even this statement must be qualified. I once carried on a series of experiments with a 500 volt current, during which I found that if one's hands are dry it is perfectly safe to take the bare wires in one's hands, but if the hands were damp with a conducting liquid, such as water, the current would cause a strong muscular contraction followed by a peculiar stinging sensation, and if the hands were moist with a highly conducting liquid such as strong sulphuric acid (it was my misfortune to do this once) nothing could tempt one to try a similar experiment with a current of a higher potential. I think it would be a wise thing if The National Electric Light Association, which is about to convene at Philadelphia, would appoint a committee to thoroughly investigate this subject of danger to human life in the use of electric light currents, experimenting on the larger animals, and furnishing the community with reliable data on this very important subject.

In the statement that, in a well installed plant there is not much danger from a 2000 volt current, the stenographer left out the words "from fire."

With an apology for thus trespassing on your columns for the purpose of correcting a personal statement, I am,

Yours very truly,

A. V. Garratt.

The Electric Light in Abilene, Kan.

The Abilene Water and Electric Light Company, Abilene, Kan., has rebuilt its entire system, and enlarged its plant by adding a 12x12 Armington & Sims engine and two No. 10 Edison dynamos.

The company now boasts of the finest pole line in the State of Kansas, and a system of lighting that cannot be excelled anywhere.

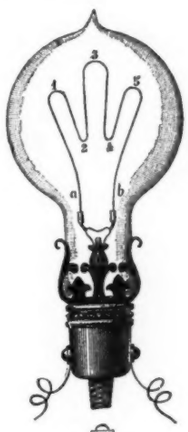
All the principal business houses, and many of the private residences, are now lighted, and a contract has been made for lighting the streets.

The lights are quite popular, and in a very short time Abilene will be more brilliantly lighted than any other city in the West.

With the Holly system of water works and the Edison incandescent electric light, the company feels that it is ready to supply all demands of the people.

A New Incandescent Lamp.

They manufacture at Steyr, in Austria, a model of incandescent lamp known under the name of Puley lamp. This lamp, which is shown in the adjoining figure, is remarkable for the form of its thread, and the matter it is composed of, and by the method of carbonizing this very thread.



They take, in order to make the thread, some manilla hemp which they shape like a clover-leaf. They use for this purpose a plate of iron upon which they fix five pins corresponding to the round angles of the thread; they put the small piece of hemp upon this shaping apparatus and they stretch it strongly by the means of a jaw which is intended to flatten at the same time the ends *a b*. To withdraw the thread from the shaping device they withdraw the two movable pins 2 and 4, and they loosen the inside jaw; they fix, by the means of points, the thread upon a cork piece and they place, it in a bath of mineral oil where it is rendered incandescent and carbonized by the passage of an electric current. The bath prevents lateral discharges from taking place as would be the case in vacuum, and it seems that in these conditions the carbonized thread presents a very even surface and a very great mechanical resistance (24 kilogrammes per square millimeter) which insures a long life to the lamp.

They afterwards galvanize the flattened ends of the thread and they solder them to the platinum wires which pass through the bulb; the ends of these platinum wires are previously turned spiral like, by the means of a very simple machine; the electrolytic deposit is a copper deposit and the soldering is made with silver.

For obtaining vacuum they resort to Geissler mercury pump. The vacuum is made in several lamps at the same time (generally 7) and they take care to render the threads incandescent, as usual, during the last part of this operation.

These lamps have a resistance of 214 ohms, and give, as it appears, with a difference of 20 volts potential at the screw posts, a 20-candle luminous power; their duration is estimated at 1000 hours.

Electricit Adopted for a New Railway in Boston.

Mr. H. M. Whitney, the promotor of the new electric road from Park Street Church to the Chestnut Hill reservoir, Boston, was found in his Boston office looking over the Electrical Review. He said: "This is a comparatively new subject for me; I had not looked into it at all until I became interested in the West End Land and Railroad enterprise, and I am astonished at the rapid progress that is making in the practical application of electricity. Inventions have been perfected, and construction of appliances and development of power so simplified and cheapened that, not only is it coming into use as a motor for street railways, promising to suppplant the horse entirely in the course of a few years, but there appears to be methods coming forward ready to make it a rival to steam on the great railway lines, claiming great advantages over the latter in every respect. You know that for our West End railway we proposed originally to use the cable as a motive power; but electricity has such undeniable superiority that we have now fully determined to adopt it. The only question now is what system to adopt. We have had propositions from several parties to equip our line with electricity and guarantee thoroughly satisfactory results. The conduit system, supplying electricity from what may be termed a third rail in the center of the track has been cheapened and simplified so that it can be applied to a railway for something like $20,000 a mile, while a cable system costs several times that sum, and even a cable is cheaper than horse power. But the storage battery system, requiring no change whatever in the ordinary street railway track, has been so perfected and cheapened that it seems the most desirable for our purposes, and we therefore incline toward that. Among the great advantages of electricity over any other power practicable for street railways is the high speed that may be obtained, with quick starting and stopping; also the ease with which it overcomes almost any grade that would be impracticable on anything else than a cable railway or one like that running up Mt. Washington. For instance, the line at Baltimore has one grade of 700 feet to the mile, while our steepest grade is but six feet in a hundred. The cars can also be brilliantly lighted by the same power that runs them."

—— The Police Board have adopted very elaborate specifications for lighting the port of Mobile, Ala. The system, as adopted and located, will consist of eleven towers, of not less than one hundred and twenty-five feet in height, of either iron or wood, with four lamps on each tower, of not less than 2,000 candle power each; also one hundred and eleven electric lamps, of not less than 2 000 candle-power each, located as per map and locality given in the accompanying list. The lower portion of tower masts (if wood is used) to be either cedar or other durable wood, not less than fourteen inches diameter at base, the entire mast, neatly dressed and painted, to be securely placed in ground, not less than ten feet beneath the surface, and securely braced. The single electric lamp poles and conducting poles to be of uniform size, ten inches diameter at base, and not ess than thirty feet in height above ground, securely placed, at least five feet below the surface. The poles to be of cedar or other durable wood—to be straight, and neatly painted. The electric lamps to be suspended in center of streets, on strong wire rope. All crossings of telegraph, fire alarm and telephone wires to be protected by insulators. These proposals require the contractor to erect, run and maintain a permanent electric system of lights, to give security for the faithful performance of his contract in such sum as the Police Board may deem necessary.

—— Last week the Western Electric Company, Chicago, sold the following electric lighting plants: J. V. Farwell & Co., 35 arc lights; Lay & Lyman, Kewanee, Ill., 25 lights; City of Chicago, new fireboat, 6 lights; F. B. Pickering, Tampa, Fla., 30 lights.

Electric Light News

—— The interior of the Washington Monument is now lighted by the incandescent light of the U. S. Electric Lighting Company.

—— The Harlem Electric Lighting Company, of this city, has applied to the council to light Third avenue from 86th street to 125th free of charge.

—— Thirteen new electric lights will be erected in Selma, Ala., at an early date. All gas lights are to be disposed of. Let the good work proceed, it is only a question of time.

—— A company of Italian capitalists has undertaken to light Rome by electricity under a new system. The plant of the company will be operated by water power, furnished by turbine wheels in the Tivoli waterfalls.

—— In lecturing before the Society of Natural History at Berlin, Professor Stricker has employed with much success an electric lamp of 4,000 candle-power for the projection of microscopic sections upon a screen, employing a magnifying power of six to eight thousand diameters. It is stated that the definition obtained is very satisfactory.

—— This subject of lighting cars is one that really calls for increased attention. A great deal of money is put into coaches for the comfort of travelers, but much luxury that we have seen provided could be well replaced by a little luxury in the way of light. The passengers think so at all events The lights that we have, by the way, are unsatisfactory more by reason of the poor care they receive than because of their intrinsic worthlessness. We have seen many excellently bright lights rendered almost entirely useless for reading purposes by their excessive vibration arising from loosened fastening. Such carelessness is inexcusable.—*Chicago Railway Review.*

—— Munson & Co., Chicago, are large manufacturers of belting, and their new Eagle and Dynamo electric light belt has won them universal favor among electric lighting companies as fast as tried. This house is a leading one, of unquestioned responsibility and the work furnished from it is sure to be reliable and satisfactory. Like many other companies, in various trades, Munson & Co. hardly realized the great demand there was for belting in the electric lighting field, and since entering it have been greeted with rapidly increasing orders.

—— The use of intermittent light to indicate the speed of engines or other moving bodies has been proposed by M. Gustave Hermitte. His plan is to illumine a Geissler tube by the sparks of an induction bobbin, giving a constant and known rate of vibration per second, say, from thirty to forty, each vibration giving a corresponding flash of the Geissler tube. By optically arresting the moving objects at different points of their course, he proposes to obtain their speed. For example, if a disc of cardboard be made to revolve by clockwork at a uniform and known speed, say, one turn per second, and if it be lighted by the Geissler tube giving thirty flashes per second, we shall see the disc thirty times during one second, or, in other words, while it makes one revolution; and if there be a visible spot on its surface, thirty spots will be seen. If the disc turn ten times per minute, the succession of images will disappear; owing to the persistence of impressions on the retina, the disc will appear to be immovable, and we shall see three spots on its circumference occupying fixed positions. If the number of turns of the disc is equal to the number of flashes of the tube the disc will be seen to be immovabe. A printed page revolved in this way could be read as if it were fixed.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING JAN. 25, 1887.

356,207 Method of insulating electric conductors; William R. Patterson, Chicago, Ill., assignor to the Western Electric Company, same place.

356,211 Dashpot for electric arc lights; Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place.

356,261 Primary voltaic battery; Jas. E. Pearce, Maidenhead, county of Berks, England.

356,270 Protector for lamp globes; Frank Bredow, Davenport, Iowa.

356,282 Electric arc lamp; August Harding, Oakland, Cal.

356,300 Telephone system; Alfred M. A. Beale, New York, N. Y.

356,360 Automatic heat indicator and distant alarm; William Gee, New York, N. Y.

356,390 Electric accumulator; Charles Barral de Montaud, Paris, France.

356,118 Electrical call-box.

356,425 Test circuit for multiple switchboard systems; Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place.

356,426 Multiple switchboard test circuit; Chas. E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place.

356,427 Factory telephone exchange; Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place.

356,496 Electrical elevator; Norton P. Otis, Yonkers, N. Y.

356,576 Electric motor; Philip Diehl, Elizabeth, N. J.

356,579 Electric locomotive; Hermann Erhardt, Boston, Mass.

356,580 Supporting frame for electric lamps; Herbert H. Fairbanks and William H. Coughlin, Worcester, Mass., assignors to the Worcester Electric Light Company, same place.

356,605 Electrical clock alarm; Milton M. Smith and Ferdinand P. Jones, Buffalo, N. Y., said Smith assignor to Josephine R. Smith, same place.

356,629 Insect-catching attachment; John S. Ezell, Woodruff's, S. C.

356,632 Electric cut-out; John Fuchs, Beardstown, Ill.

356,640 Process of manufacturing amalgams by electrolysis; Arthur S. Hickley, Montreal, Quebec, Canada, assignor, by mesne assignments, to the Electric Amalgam Company, of Maine.

356,667 Dynamo-electric machine; Sidney H. Short, Denver, Col.

356,688 and 356,689 Telephone; Edward H. Johnson, New York, N. Y.

356,727 Galvanic cell; Nelson W. Perry, Norwood, assignor of part to Frederick Forchheimer and Herman J. Groesback, both of Cincinnati, Ohio.

RE-ISSUES.

10,802 Electric valve; Warren L. Johnson, Milwaukee, Wis., assignor to the Johnson Electric Service Company, same place.

BUSINESS NOTICE.

Notice is hereby given, that the co-partnership heretofore conducted under the firm-name and title of VALLEE & BRO., at 1210 Market street, has been dissolved by mutual consent, and that a co-partnership between the undersigned has been this day formed under the name and style of VALLEE BROS. & Co., at 932 Arch street, for the purpose of manufacturing and dealing in electrical supplies, and the construction of electrical and pneumatic work of every description. We respectfully ask a continuance of your patronage.

GARRETT A. VALLEE.
GEO. W. VALLEE.
A. V. ZANE, JR.

Your attention is particularly called to our new address, 932 Arch street.

Philadelphia, Jan. 15th, 1887.

Wanted—Copy of Electrical Patents Edition, published by the Commissioner of Patents in 1880, containing complete reprint of all the electrical patents issued by the U. S. prior to 1880. A liberal price will be paid for one copy of above book.

Address Electric, care ELECTRICAL REVIEW, Box 3329, New York.

BUSINESS NOTICE.

"In making the statements which follow we can verify each and all of them as facts. Mr. Edward P. Thompson, of Temple Court (7 Beekman St.), New York, is a good man to bring your patent cases to, for he is thoroughly versed in all the ins and outs of a Patent Attorney's duties. The following are some of his qualifications: Graduate of Stevens Institute as Mechanical Engineer. For four years tutor of classes of young men in mathematics and experimental physics at Elizabeth, N. J. Served professionally as Electrician and Chemist in the Swan Electric Company of New York for two years. Because of past successes as a Patent Attorney at 13 Park Row, New York, was appointed to succeed N. S. Keith, of the patent agency of the *Electrical World* and Associate Editor. N. S. Keith is known as the Translator and Reviser of Schellen's Treatise on "Dynamo Electric Machinery." Mr. Thompson for two years personally prepared and prosecuted all the patent business of *Electrical World's* Patent Agency, and is the author of a series of articles in said paper upon "Analytical and Systematic Method of Inventing," which were widely known and favorably received. Mr. Thompson is a member of American Institute of Electrical Engineers and American Society of Mechanical Engineers. He is author of the "Expansion of Polynomials," which the ablest mathematicians of the world universally commend."—*New York Observer*.

THE ANNUAL MEETING

—OF—

The National Electric Light Assoc'n.

WILL BE HELD IN PHILADELPHIA,

—AT THE—

HOTEL LAFAYETTE,

—ON—

TUESDAY, FEBRUARY 15, '87

AT 12 O'CLOCK M.

The Executive Committee will meet at the same place on Monday the 14th, at 3 P. M.

Members requiring Hotel Accommodations will please address,

A. J. DE CAMP,
Chairman Executive Com.,
stating what is required.

PAINE & LADD,

HALBERT E. PAINE, Late Commissioner of Patents. | STORY B. LADD.

Attorneys in Patent Causes And Solicitors of Patents.

WASHINGTON, D. C.

Detroit Electrical Works

MANUFACTURERS OF

ELECTRIC SUPPLIES,

INCLUDING

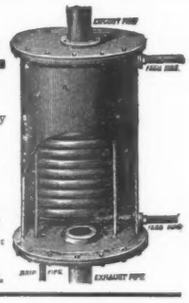
Medical Batteries, Skeleton and Box Bells, Burglar Alarms, House Annunciators, Fire Alarm Boxes, Pins, and Brackets,

INSULATED MAGNET, TELEPHONE AND ELECTRIC LIGHT WIRE.

GENERAL OFFICES and FACTORY:
DETROIT, MICHIGAN.

THE

National Feed Water Heater.



A BRASS COIL HEATER,

Supplying feed water to the boiler at 206° to 212° F. A reliable and very effective heater. Over 1,500 in use in the United States.

150 Electric Light Stations Supplied, and Orders being filled every week.

Seventeen sizes manufactured, from 8 to 2,000 H.P.

PRICES LOW AND SATISFACTION UNIVERSAL.

THE NATIONAL PIPE BENDING CO

84 River Street, New Haven, Conn,

Coils and Bends of Brass and Copper Pipe Made to Order.

Fig.259

PHOENIX GLASS COMPANY,

(Works, Water Cure, Beaver County, Penn.)

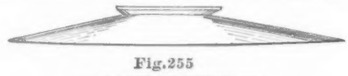


Fig.255

—MANUFACTURERS OF—

A FULL LINE OF ELECTRIC LIGHT GLOBES & SHADES, BOTH ARC AND INCANDESCENT,

In Opal, Flint and Art Glass Effects, in Opalescent and other Colors,

A. H. PATTERSON, Manager. **729 BROADWAY, COR. WAVERLEY PLACE, NEW YORK.**

Leclanché,

The Standard Open-Circuit Batteries of the World.

GONDA (FORMERLY PRISM) CELL, COMPLETE.

GONDA and DISQUE,

The Only Genuine Leclanché Batteries

Are those which bear this LABEL and the Trade-Mark, GONDA.

DO NOT BE IMPOSED UPON BY IMITATIONS.

If dealers have not the Genuine Battery, send direct to us for Price-List.

THE LECLANCHÉ BATTERY CO.,

149 West Eighteenth Street, New York.

GENUINE DISQUE CELL, COMPLETE. The Porous Cell also bears Label.

Standard + Electrical + Works,

MANUFACTURERS OF

TELEGRAPH AND TELEPHONE APPARATUS,

Hotel and House Annunciators, Burglar Alarms,

CALL BELLS, "POST'S" MAGNETO BELLS,

PINS and BRACKETS, BATTERIES, &c., &c.

IN STOCK:—FULL LINE

IRON, STEEL and HARD-DRAWN COPPER WIRE, Delivered at Lowest Prices.

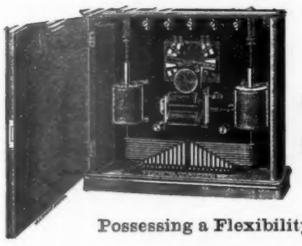
☞ ESTIMATES FURNISHED. SEND FOR CATALOGUES AND PRICES. ☜

Cincinnati, Ohio, U. S. A.

SUN ELECTRIC COMPANY,

WOBURN, MASS.,

MANUFACTURERS OF THE



BEST SYSTEM

OF

Incandescent Lighting

ON ARC LIGHT CIRCUITS.

Possessing a Flexibility Equal to Low Tension Distribution.

Our Lamps possess Durability and Brilliancy Equal to the Very Best in the Market.

UNION FIRE ALARM CO.

145 BROADWAY, NEW YORK,

ARE NOW PREPARED TO FURNISH THE CHEAPEST, BEST AND MOST COMPLETE

FIRE ALARM SYSTEM

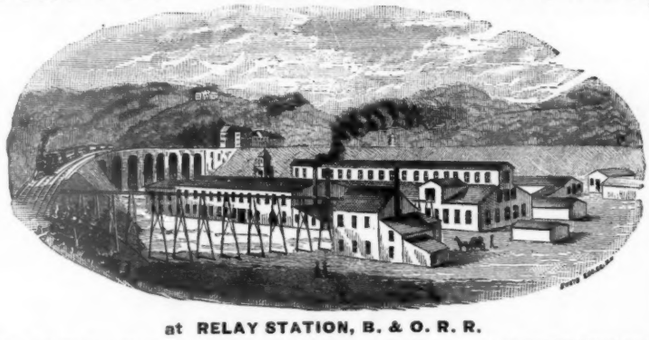
EVER DEVISED.

PARTICULARLY ADAPTED TO SMALL CITIES AND TOWNS.

WE DEFY COMPETITION.

Correspondence Solicited and Estimates Furnished.

VIADUCT ELECTRICAL WORKS,



at RELAY STATION, B. & O. R. R.

Office, N. W. Cor. Charles and German Sts., Baltimore, M. D. A. C. DAVIS, President.

PURCHASE ELECTRICAL GOODS DIRECT FROM MANUFACTURERS, AND SAVE ALL DISCOUNTS, COMMISSIONS, ETC.

USE MAGNETO SIGNAL BELLS. (No battery.) Protect your house with BURGLAR ALARMS, light your gas with ELECTRIC BURNERS, safer, cleaner and cheaper than matches.

HOTELS—Use our GUEST CALL, to awaken and call guests by sounding a bell in each room; invaluable at all times, but especially so in case of fire.

FACTORIES, STORES—Summon foreman, porter, janitor or other employees on different floors with our MAGNETO BELL. Always in order.

NOTE—Send for Catalogue and mention this Paper.

THE

ELECTRICAL ACCUMULATOR CO.,

MANUFACTURERS OF

STORAGE BATTERIES

OFFICE: 44 BROADWAY, NEW YORK.

Factory: NEWARK, N. J.

THE CLEVERLY ELECTRICAL WORKS,

1018 Chestnut Street, Philadelphia.

ELECTRICAL SUPPLY MAKERS.

PHOSPHOR BRONZE TELEPHONE WIRE.

"Phosphor-Bronze."

SPRING SHEET and SPRING WIRE for ELECTRICAL APPARATUS.

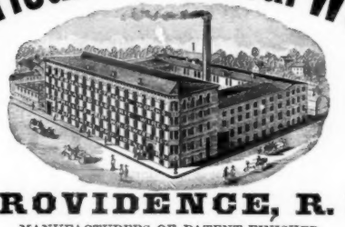
THE PHOSPHOR BRONZE SMELTING CO., LIMITED.

512 ARCH ST., PHILADELPHIA, PA.

Owners of the United States Phosphor Bronze Patents. Sole Manufacturers of Phosphor Bronze in the United States.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

American Electrical Works



PROVIDENCE, R. I.

MANUFACTURERS OF PATENT FINISHED

INSULATED ELECTRIC WIRES

TELEPHONE & INCANDESCENT CORDS.

ELECTRIC LIGHT WIRE

MAGNET WIRE, PATENT RUBBER-COVERED WIRE, LEAD-ENCASED WIRE, FLEXIBLE CORDAGE, OFFICE AND ANNUNCIATOR WIRE.

UNDERGROUND & AERIAL CABLES

New York Office: 15 Cortlandt St.

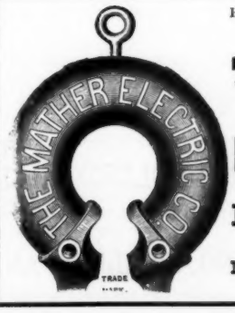
HARRY HALL, Agent.

BUSINESS NOTICE.

NEW BANKING FIRM.—We have formed a co-partnership to transact a banking and brokerage business under the firm-name of CLEVELAND, WHITNEY & Co., at No. 7 Exchange place, opposite Stock Exchange, Boston. Will buy and sell on commission, for cash or on margin. Stocks and bonds at all the exchanges. We shall give special attention to investment securities and the negotiation of loans. Correspondence solicited. Private wires.

H. M. CLEVELAND.
R. H. WHITNEY.

Boston, Jan. 1, 1887.



H. G. CHENEY, President. P. H. WOODWARD, Secretary and Treasurer. ROBERT CHENEY, Vice-President.
N. T. PULSIFER, General Manager. R. H. MATHER, Con. Electrician.

THE MATHER ELECTRIC CO.

HARTFORD, CONN.,

Sole Manufacturers under all the Patents of Richard H. Mather for

Electric Lighting and Transmission of Power.

Also Sole Manufacturers under all the Patents of Charles G. Perkins for

Incandescent Lamps and Appliances for Incandescent Lighting.

EXECUTIVE OFFICE, HARTFORD, CONN.

New York Office, 145 Broadway. Cincinnati Office, Carlisle Building.
Chicago Office, 117 and 119 Lake St. Philadelphia Office, 11 North Juniper St.

PROTECTION FOR WATCHES.

—The Anti-Magnetic Shield is an absolute protection from all Electric and Magnetic Influence. Can be applied to any watch. Full Experimental Exhibition and Examination, also full assortment of the watches complete at

F. S. GILES, Agent, or GILES, BRO. & CO., Chicago, Ill.

ANTI-MAGNETIC SHIELD & WATCH CASE CO., 18 John St., New York.

W. H. Masters, President W. K. Lawrence, Manager

THE NATIONAL CARBON CO.

CLEVELAND, OHIO.

MAKERS OF ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

—THE—

SOLAR CARBON & MFG. CO.

(Works near Pittsburgh, Pa.)

Electric Light men know the trouble arising from impurities in Carbons. This Company obtains its supply of Carbon from NATURAL GAS, and such gas is used throughout the process. Hence they claim to sell a CHEMICALLY PURE Carbon, unequaled in brilliancy and life.

Selling Agents:

VITRITE & LUMINOID CO., 14 Dey St. New York.

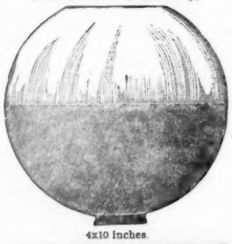
S. B. RICHARDS, M'g'r General Eastern Office, 55 S. 3d St., Philadelphia.

A PERFECT ELECTRIC LIGHT GLOBE.

THE UNION GLASS COMPANY,

BOSTON, MASS., U. S. A.,

HALF GROUND (Horizontally).



4x10 inches.

MANUFACTURERS OF EVERY DESCRIPTION OF

ARC AND INCANDESCENT

ELECTRIC-LIGHT GLOBES

SEND FOR PRICE-LIST.

THE

LITTLE--McDONALD CUT--OUT.

PATENTED MAY 20, 1886. 1,000 IN USE.

SEND FOR CIRCULARS AND PRICES

J. A. POWERS,

TROY, NEW YORK.

THE ELECTRICAL SUPPLY CO.

Manufacturers of and Dealers in

ELECTRICAL INSTRUMENTS and SUPPLIES.

Being Manufacturers of Bare and Insulated Wires and Cables of every description, we are prepared to give prices for large quantities.

We Manufacture the Celebrated Wallace Diamond Carbons for Electric Lights, which are Superior to all others.

OUR NEW ILLUSTRATED CATALOGUE WILL BE MAILED TO ANY ADDRESS FREE OF CHARGE.

THE ELECTRICAL SUPPLY CO.

171 Randolph Street, Chicago, and 17 Dey Street, New York.

LOWEST PRICES FOR

BELLS,

HAZAZER & STANLEY,

32 FRANKFORT ST., New York.

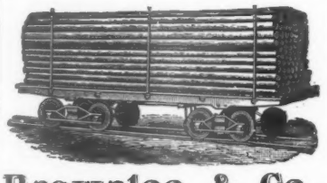
STANDARD

Electrical Test Instruments.

Galvanometers, Resistance Coils, Condensers, Keys, Switches, &c., Bailey Combination Set, Pratt's Speed Indicator, &c.

Electric Mfg. Co., Troy, N. Y.

OFFICE, 311 RIVER STREET.



Brownlee & Co.,

DETROIT, MICH.

DEALERS IN

Cedar Telegraph Poles

MANUFACTURERS OF

Cross Arms, Pins and Brackets,

OAK AND LOCUST PINS,

BROWNLEE'S CONCAVED BRACKET.

Patent applied for.) Send for Catalogue

GIVES MORE POWER USING LESS WATER THAN ANY OTHER WHEEL.

JAMES LEFFEL & CO.

SPRINGFIELD, O., OR 110 LIBERTY ST., N. Y.

ALFRED F. MOORE,

Manufacturer of

Insulated Wire,

for Telephone, Telegraph and Electric Light.

OFFICE, LINE, AND

Annunciator Wire,

Magnet Wire, and Flexible Cordage,

200 & 202 N. THIRD ST.

PHILADELPHIA, PA.

CARBONS

BOULTON CARBON CO.

FORMERLY

Boulton Standard Carbon Comp'y,

CLEVELAND, OHIO.

We do not brag about our Carbons, but we challenge the World to produce a better.

D. W. Baker. C. O. Baker, Jr.

BAKER & CO.,

Importers, Melters and Refiners of

PLATINUM,

408, 410, 412 and 414 N. J. R.R. Ave., NEWARK, N. J.

Platinum in sheet and wire, all sizes, and any degree of hardness. Scrap and native platinum purchased.

JOHNSON HEAT-REGULATING APPARATUS.

Can be attached to any kind of heating apparatus ever made, and by its use the heating of buildings to a uniform temperature is accomplished. Rooms may be kept at any temperature desired, thereby saving fuel, discomfort, ill health, the cracking of wood-work, furniture and pictures, and the danger of fire by over heating. This apparatus applies equally well to all forms of heating and ventilating devices, the thermometer in the room automatically governing the temperature. It is invaluable in Public Buildings, Private Residences, Business offices, Hospitals, Churches, Schools, Conservatories, Factories, etc.

SEND FOR CIRCULAR "R."

NATIONAL ELECTRIC SERVICE CO.

NEW YORK, 686 Broadway. CHICAGO, 195 Wabash Avenue. BOSTON, 611 Washington Street.

Poole & Hunt's Leffel Turbine Water Wheel.

Made of Best Materials and in the Best Style of Workmanship.

MACHINE-MOLDED MILL GEARING,

From 1 to 20 feet diameter, of any desired face or pitch, molded by our own special machinery.

SHAFTING, PULLEYS AND HANGERS

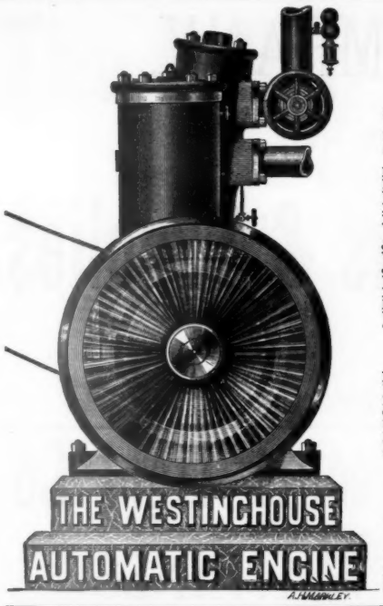
Of the latest and most improved designs.

Transmission Machinery

A SPECIALTY.

☞ Special attention given to Heavy Gearing. Shipping facilities the best in all directions.

POOLE & HUNT, Baltimore, Md.



THE WESTINGHOUSE MACHINE CO.

SALES LIST FOR NOVEMBER. 1886.

			H. P.
South Side E. L. Co.,		Pittsburgh, Pa.	150
" "	2d order,	" "	150
Union Switch & Signal Co.,	6th order,	" "	75
East End E. L. Co.,	2d order,	" "	75
" "	3d order,	" "	75
Brush Electric Light Co ,	2d order,	Buffalo, N. Y.	60
McConway & Torley,	2d order,	Pittsburgh, Pa.	60
Winona Paper Co.,	4th order,	Holyoke, Mass.	60
New York & Manhattan R. E Co.,		New York.	60
Mather Electric Co.,		Hartford, Ct.	60
" "	2d order,	" "	60
Jefferson City E. L. Co.,		Jefferson City, Mo.	60
Wahoo E. L. Co.,		Wahoo, Neb.	60
J. C. Livingston & Co.,		Little Falls, N. Y,	45
Weidman Silk Dyeing Co.,		Paterson, N. J.	45
Miller, Broudy & Co.,		Alexandria, La.	45
E. L. McLain Mfg. Co..	2d order,	Greenfield, O.	45
Van Deventer & Horne,		Plainfield, N. J.,	35
"The Public Ledger,"	2d order,	Philadelphia, Pa.	35
" "	3d order,	" "	35
" "	4th order,	" "	35
" "	5th order,	" "	35
E. Balbach & Son,	14th order,	" "	35
Wolff & Hamaker,		Chambersburg, Pa.	35
Imperial Guano Co.,		Norfolk, Va.	35
Chandler & Price,		Cleveland, O.	35
Wabash, St. L. & Pacific R. R.	2d order,	Ft. Wayne, Ind.	35
Barnes Bros.,		Maquoketa Ia.	35
A. J. Mullen,		Selma, Ala.	35

			H. P.
Brainard & Shephard,		Albany, N. Y.	25
Henry Warden,		Philadelphia, Pa.	25
Crown Mills,		Marcellus, N. Y.	25
S. R. Cain,		Bristol, Vt.	25
Wabash, St. L. & Pacific R. R.	3d order,	Ft. Wayne, Ind.	25
Minneapolis Gas Light Co.,		Minneapolis, Minn.	25
" " "	2d order,	" "	25
Thos. Henshall,		Paterson, N. J.	15
E. Balbach & Son,	15th order,	Newark, N. J.	15
Gas Engine and Power Co.,		New York.	15
Roulleaux, Dugaze & Co.,	2d order,	Surcenes, Fr.	15
Shickle, Harrison & Howard	2d order,	St. Louis, Mo.	15
McCord, Ford & Co.,		Colfax, W. T.	15
Decatur Furnace Co.,		Decatur, Ala.	15
Lawrence Machine Shop,	15th order,	Lawrence, Mass.	10
" "	16th order,	" "	10
N. W. Wait, Son & Co.,		Sandy Hill, N. Y.	10
F. S. Cole,		Grundy City, Ia.	10
Union Pacific R. R ,	2d order,	Omaha, Neb.	10
Geo. C. Howard,		Philadelphia, Pa.	5
Merritt W. Burwell,		New Haven, Ct.	5
Westinghouse Electric Co.,	3d order,	Pittsburgh, Pa.	5
Lawrence Machine Shop,	17th order,	Lawrence, Mass.	5
" "	18th order,	" "	5
J. A. Diamond,		Indianoplis, Ind.	5
F. J. Yandle,		Santa Rosa, Cal.	5
Aberdeen Packing Co.,		Astoria, Or,	5
TOTAL, 56 ENGINES,			1975

Sales Department for the U. S. Conducted by

WESTINGHOUSE, CHURCH, KERR & CO., 17 Cortlandt St., N. Y.; 98 Fourth Ave., Pittsburgh, Pa.
FAIRBANKS, MORSE & CO., Chicago, Ill.
FAIRBANKS & CO., St. Louis, Mo.
PARKE & LACY, San Francisco, Cal.
[illegible] MACHINERY CO., Salt Lake, Utah.
D. A. TOMPKINS & CO., Charlotte, N. C.
ROBERT MIDDLETON, Mobile, Ala.
H. DUDLEY COLEMAN, New Orleans, La.
KEATING IMPLEMENT & MACHINE CO., Dallas, Texas.

WESTINGHOUSE, CHURCH, KERR & CO.

17 CORTLANDT ST., NEW YORK. 98 FOURTH AVENUE, PITTSBURGH, PA.

Engineers and Contractors for Central Stations for Incandescent Lighting on the

WESTINGHOUSE ELECTRIC COMPANY'S SYSTEM.

Isolated Incandescent Plants. Direc -connected Centrifugal Pumping Machinery.
Steam Power Plants for Manufacturers. Designers of Sp cial Applications of Steam Power.

THE WESTINGHOUSE ELECTRIC COMPANY,

MANUFACTURERS OF ISOLATED INCANDESCENT PLANTS, AND CONTRACTORS FOR CENTRAL STATIONS.

It is believed that the advantages of our system place us beyond competition.
Capital investing for dividends will do well to close no contracts till our proposals are considered.

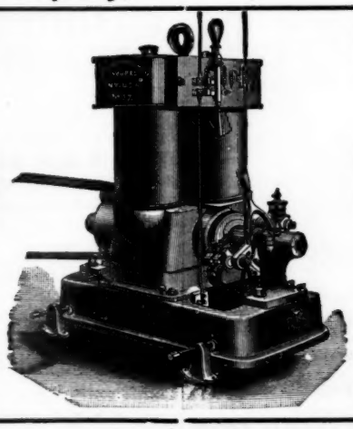
The Westinghouse Electric Company, - - - Pittsburgh, Pa.

16 C. P. LAMP, (half-size.)

EDISON LIGHT.

The Edison United Mfg. Company,

65 FIFTH AVE., NEW YORK.



Estimates Furnished For Isolated Plants,

For use in Mills, Hotels, Theatres, Steamboats, etc.

EDISON LIGHT.

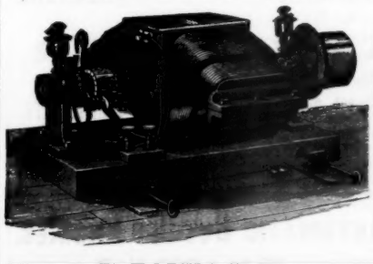
THE American Bell Telephone Company,

95 MILK ST., BOSTON, MASS.

This Company owns the Letters Patent granted to Alexander Graham Bell, March 7th, 1876, No. 174,465, and January 30, 1877, No. 186,787.

The Transmission of Speech by all known forms of ELECTRIC SPEAKING TELEPHONES infringes the right secured to this Company by the above patents, and renders each individual user of telephones, not furnished by it or its licensees, responsible for such unlawful use, and all the consequences thereof and liable to suit therefor.

HECLA ELECTRIC LIGHT COMPANY,



MANUFACTURERS OF THE

Jackson Dynamo-Electric Machines, Lamps, Etc.

For Arc and Incandescent Lighting.

Size A, capacity 20 16 c. p. lamps Price, $160
Size B, capacity 30 16 c. p. lamps. Price, $200
Size C, capacity 50 16 c. p. lamps. Price, $340

—ALSO—

ELECTRICAL SUPPLIES OF ALL KINDS ALWAYS IN STOCK.

Estimates for complete Electric Light and Steam Plants made on application. Send for Circular, and mention this paper.

OFFICE:

26½ E. 42d St., New York.

Thermostats and Thermostatic Fire-Alarm Apparatus.

Thermostat Two-thirds Actual Size.

OUR PATENT CLOSED-CIRCUIT SYSTEM IS ABSOLUTELY RELIABLE AND ECONOMICAL, AND DOES NOT GIVE A FALSE ALARM WHEN THE CIRCUIT IS BROKEN ACCIDENTALLY.

Our patent hydro-carbon thermostat is ornamental, adjustable and never ailing, closing or opening the circuit with great force, and does not destroy itself by use. A sample thermostat mailed on receipt of one dollar.
Territorial rights and licences can now be negotiated.

SEND FOR CIRCULAR TO

The Martin-Wilson Automatic Fire Alarm Co., 53 State St., Boston, Mass.

WESTERN ELECTRIC COMPANY,

CHICAGO—NEW YORK—ANTWERP—LONDON.

Telegraph & Telephone Apparatus & Supplies.

The Best of Everything at Bottom Prices.

Roberts-Brevoort Electric Co.

(LIMITED,)

Manufacturers of

THE ROBERTS PER-OXIDE BATTERY

AND

THE ROBERTS DRY BATTERY.

These batteries have each about 1.8 volts. The Per-O-ide Battery is intended for severe open-circuit work. Our dry Battery is **something entirely new.** It is put up in a sealed cell: **no fluid to spill;** can be used in **any position.**

Liberal trade discount. Send for Price List and Circular to the company's office.

Per-Oxide Battery	**$1.00**
Dry Battery	**$1.50**

206 Broadway, New York.

FOR SALE BY ALL DEALERS.

SCHAEFER ELECTRIC MFG. CO.

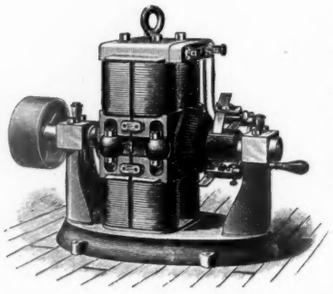
INCANDESCENT LAMPS, From 10 to 100 Candle Power. DYNAMO MACHINES of Improved Construction.

Proposals and Estimates furnished for Complete Installations of Incandescent plants upon application to

P. O. Box, 3068, Boston, Mass.

FACTORY AT CAMBRIDGEPORT, MASS.

The Waterhouse Electric & Mfg. Co.



OFFICERS AND DIRECTO S.

Asa S. Cook	Pres't and Treas.
S. W. Bishop	Vice-Pres't.
Addison G. Waterhouse	Electrician
Chas. E. Chapin	Secretary.
Samuel O. Prentice	Attorney.
Francis A Pratt	Pres The Pratt & Whitney Co.
Chas. E. Billings	" The Billings & Spencer Co.
Geo. M. Bond, M.E.	Mgr. Gauge Dep't P. & W. Co.

The WATERHOUSE SYSTEM

IS

STRICTLY FIRST-CLASS

AND PRODUCES A

Noiseless, Steady Light.

Factory, Colt's West Armory. HARTFORD, CONN.

FRANKLIN S. CARTER. CHAS. M. WILKINS. E. WARD WILKINS.

ESTABLISHED 1867.

PARTRICK & CARTER,

Manufacturers of and Dealers in every description of

ELECTRICAL SUPPLIES for the TELEGRAPH, TELEPHONE, ELECTRIC LIGHT, ETC.

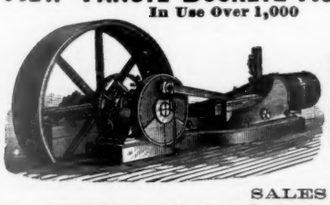
Sole proprietors of the Patent Needle Annunciator. Annunciators, Burglar Alarms, Electric Bells, Batteries, Wire, etc. Illustrated catalogues and price lists sent free.

No. 114 SOUTH SECOND STREET, - - PHILADELPHIA, PA.

NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES.

In Use Over 1,000

25 to 1,000 H. P.



These Engines are the combined result of long experience with automatic cut-off regulation and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-Contained Automatic Cut-off Engines, 12 to 100 H.P. for driving Dynamo Machines a SPECIALTY.—Illustrated Circulars with various data as to practical Steam Engine Construction and performance, free by mail. Address

BUCKEYE ENGINE CO., Salem, O.

SALES AGENTS:

W. L. SIMPSON, Eastern Sales Agent, No. 70 Astor House, New York

ROBINSON & CAREY, St. Paul, Minn.

N. W. ROBINSON, cor Clinton and Jackson Sts., Chicago, Ill.

and PRAY MANUFACTURING CO., Minneapolis, Minn.

Schuyler Electric Light Co.,

Manufacturers of

DYNAMO MACHINES FOR INCANDESCENT AND ARC.

The most perfect system of both Incandescent and Arc Lighting. Entire freedom from hissing and flickering in our Arc Lights, and long life and great brilliancy in our Incandescent Lights.

Dynamo Machines with perfect automatic regulation, reliable and efficient.

Prices moderate. Estimates made for lighting from Central Stations or for isolated plants. Illustrated Circulars sent upon application. Address

New York Office: No. 44 BROADWAY.

SCHUYLER ELECTRIC LIGHT CO., Hartford, Conn

MITCHELL, VANCE & CO.,

GAS FIXTURE MANUFACTURERS,

Have added a department for the Manufacture of Electroliers and other fixtures adaptable to any system of Incandescent Electric Lighting, also Combination Fixtures for both Gas and Electric Light Estimates and designs furnished upon application.

836 & 838 BROADWAY.

NEW YORK

THE

AMERICAN ELECTRICAL DIRECTORY,

Handsomely Bound and Finished in Cloth, Containing 500 pages devoted to the

INTERESTS OF ELECTRIC LIGHTING.

A Complete List of All and a Report of

Each Electric Light Co. in North America

A Handy Book for Reference.

—PRICE, $2.00—

Published by the

STAR IRON TOWER CO.,

Fort Wayne, Ind., U. S. A.

MUNSON & CO.,

Main Office & Factory, 240 & 242 Randolph Street, CHICAGO

Pacific Branch, 21 First St., San Francisco, Cal.

We gladly testify to the superiority of the

MUNSON

Eagle & Dynamo Electric Light Belt.

The stretch, otherwise than the elasticity, is removed, no rivets and perfect evenness in heft, the result noiseless with a perfect motion, which is absolutely essential for a steady light. We use no other make. The character and responsibility of the house is unquestioned.

TESTIMONIALS.

Western Edison Light Co., H. WARD LEONARD, General Sup't.

W. J. Buckley, Mgr. Ft. Wayne Jenny El. Light Co.

Thomson-Houston Electric Light, Herbert Wadsworth, Manager Western Office.

Brush Electric Co., Alex. Kempt, Special Agent.

Excelsior Electric Co., C. J. Reilly, Western Mgr.

Sperry Electric Light Motor & Car Brake Co., 201 Royal Insurance Building.

J. H. Reid, General Manager of the Mather Electric Light Co., Chicago.

Wm. H. Purdey, Comm. of Public Works, Chicago.

John Mab, Chief Engin'r of Board of Trade, Chic.

C. J. Meimes, Gen'l Sup't Thomson-Houston Light, Omaha, Neb.

J. A. Corbey, St. Joe Electric Light and Power Co., St. Joe, Mo.

Wm. Oswald, Agt. Edison Light Co., New Orleans, La.

SHEPARD'S $60. CELEBRATED

Screw-Cutting Foot Lathe.

CAP LATHE, $125.

Foot and Power Lathes, Drill Presses, Scrolls, Saw Attachments, Chucks, Mandrels, Twist Drills, Dogs, Calipers, &c. Send for catalogue of outfits for amateurs or artisans. Address,

H. L. SHEPARD, Agt.,

134 E. SECOND STREET, CINCINNATI, O.

OUR NEW

LECLANCHE FARADIC MEDICAL BATTERY

Our Leclanche Faradic Medical Battery is of a new and entirely original design.

It is a new departure, and avoids the use of all obnoxious acids that destroy the clothes, stain the hands and make the constant handling of such medical batteries absolutely dangerous.

It is simplicity itself, and in ordinary use will run ONE YEAR WITHOUT ANY ATTENTION, OR THE EXPENDITURE OF A SINGLE PENNY FOR SUPPLIES.

There is no zinc to raise or lower, no fluids to be renewed. It is always ready, and does not corrode when not in use. Its first cost and the subsequent expense is far less than that of the dangerous red or white acid batteries heretofore manufactured.

The LECLANCHE FARADIC has three currents, is nickel-plated and mounted in an ornamentally covered case, 8½x6¾x5¼ inches in size, and sold at the low price of **$8.50.**

E. S. CREELEY & CO.

(Successors to L. G. TILLOTSON & CO.,)

Manufacturers, Importers and Dealers in

TELEGRAPH, TELEPHONE AND ELECTRICAL INSTRUMENTS and MATERIAL OF EVERY DESCRIPTION,

Nos. 5 and 7 DEY STREET - - NEW YORK.

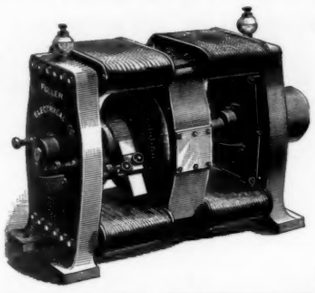
The Fuller-Wood Electric Light Co. (Limited),

228 WEST 23d STREET, NEW YORK.

OFFER FOR SALE

Improved Gramme Dynamos.

For 1 Light	of 6000	Candle Power.		
" 3 Lights	" 2500	"	"	each.
" 8 "	" 2000	"	"	"
" 10 "	" 2000	"	"	"
" 16 "	" 2000	"	"	"
" 23 "	" 2000	"	"	"
" 50 "	" 2000	"	"	"



AT GREATLY REDUCED PRICES,

ARC LAMPS.

Single	6000	Candle	Power.
"	2000	"	"
Duplex	2000	"	"
Focusing	6000	"	"
"	2000	"	"

PROJECTORS, HEADLIGHTS, &c

JARVIS ENGINEERING CO.,

BOSTON, MASSACHUSETTS.

CONTRACTORS FOR

Complete Steam Outfits for Electric Lighting Stations, Steel Boilers with Jarvis Furnaces to burn cheap fuels, Armington & Sims Engines, Etc.

SEND FOR CIRCULARS.

SHAW & GEARY

MANUFACTURERS OF

ELECTRICAL APPLIANCES

Special Tools and Dies. Model and Experimental Work a specialty.

Nos. 53 and 55 North Seventh Street, Philadelphia.

J. E. JEFFORDS & CO.

Manufacturers to the Trade.

POROUS CELLS

Of Every Description, Made to Order.

25 years' experience in this branch of the business.

2716 to 2738 Salmon St., Philadelphia, Pa.

Wellington Belt Holder

The simplest, cheapest and handiest device in existence for shifting Dynamo Belts. Please write for circulars to

W. R. Santley & Co.

WELLINGTON, O.

There are now in use over 18,000

OTTO GAS ENGINES.

Guaranteed to Consume 25 to 75 Per Cent. Less Gas than ANY OTHER GAS ENGINE Per Brake Horse-power.

Works without boiler, steam, coal, ashes or attendance. Successfully adapted instead of steam power in all industries and offers special advantages for running electrical machinery for Telegraph and Telephone as well as Lighting purposes.

OTTO GAS ENGINE WORKS,

SCHLEICHER, SCHUMM & CO.

N. E. corner 33d & Walnut Sts., Phila.

Branch Office: 130 Washington St., Chicago.

SAWYER-MAN ELECTRIC CO.

Licensed by and Succeeding to the Commercial Business of the

Consolidated Electric Light Company,

—OWNERS OF THE SAWYER-MAN PATENTS.—

GENERAL OFFICES:

Mutual Life Building,

No. 32 NASSAU ST.,

N. Y. City.

PHILADELPHIA OFFICE,

No. 205 Walnut Place.

BOSTON OFFICE,

No. 33 FEDERAL ST.

The DYNAMO of this Company is AUTOMATIC in its regulation, and will Maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

Plans and Estimates Furnished for all kinds of Incandescent Lighting.

ESTIMATES FURNISHED FOR THE THOMSON-HOUSTON SYSTEM OF ARC LIGHTING.

STANDARD UNDERGROUND CABLE COM'Y.

GEO. WESTINGHOUSE, Jr., President. RICHARD A. WARING, Vice-President.
JOHN. H. DALZELL, Treasurer. C. H. JACKSON, Secretary.

DIRECTORS—GEO. WESTINGHOUSE, JR., RICHARD S. WARING, MARK W. WATSON, JOHN H. DALZELL, ROBERT PITCAIRN, O. T. WARING and C. H. JACKSON.

Manufacturers of

The WARING ANTI-INDUCTION and BUNCHED

Telegraph, Telephone and Electric Light, Underground and Submarine

CABLES,

LEAD COVERED WIRE FOR INSIDE USE, PROOF AGAINST DAMPNESS.

128 Pearl St., N. Y. City, { All Work Guaranteed. } Hamilton Building, 91 5th Ave., Pittsburgh, Pa.

NEW ENGLAND GLASS WORKS,

29 MURRAY ST., NEW YORK. 155 FRANKLIN ST., BOSTON.

10 In.—Roughed all over.

10 In.—Opal.

9 In.—½ Horizontal Roughed.

12 In.—½ Vertical Roughed.

14 In.—Clear Flint.

WE MAKE A SPECIALTY

OF

ELECTRIC GLOBES,

OF ALL SHAPES, IN

Clear, Roughed, or Opal Glass.

Our Facilities Enable us to Offer Special Inducements in

QUALITY AND PRICE.

W. L. LIBBEY & SON,

BOSTON, MASS.

SEND FOR PRICES.

ELECTRICAL TEST INSTRUMENTS.

MADE BY THE ELECTRIC MFG. CO. OF TROY, N. Y.

GOODS FROM STOCK IN NEW YORK.

VITRITE AND LUMINOID COMPANY, Agents, 14 DEY ST., N. Y.

VICTOR

Turbine Water Wheel.

The attention of **Electric Companies** is called to this **celebrated water wheel** as particularly adapted to their use, on account of its **remarkably steady motion, high speed** and **great efficiency,** and **large capacity** for its **diameter,** being **double** the **power** of most **wheels** of **same diameter.** It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent. of useful effect, **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

(Please Mention this Paper.)

A GREAT COMBINATION OF GAS AND ELECTRIC LIGHT INTERESTS.

THE AMERICAN SYSTEM THE PIONEER OF THE NEW DEPARTURE.

ELECTRIC LIGHTING AS DEMONSTRATED BY THE

AMERICAN ELECTRIC MANUFACTURING CO.

EXECUTIVE OFFICES:

MUTUAL LIFE BUILDING, 146 BROADWAY, NEW YORK, U. S. A.

OFFICERS:

EDWARDS H. GOFF, President and General Manager; L. M. BATES, Vice-President; H. E. IRVINE, Secretary and Treasurer; JAMES J. WOOD, Electrician.

GENERAL AGENCIES:

American Electric Construction Company, 146 Broadway, New York—New York State.
St. Paul Gas Co., St. Paul, Minn.—State of Minnesota.
Citizens' Gas Light Co., Jacksonville, Fla.—State of Florida.
Sowdon, Elder & Wright, 131 Devonshire St., Boston.—New England States (except Connecticut.)
Pittsburgh Electric Company, Eugene Ingold, General Manager, 213 Wood St., Pittsburgh, Pa.—Western Pennsylvania, Ohio, Kentucky and West Virginia.
J. M. Chipman, 19 North Pennsylvania St., Indianapolis, Ind.—State of Indiana.
Markle Engineering Company, Detroit, Mich.—State of Michigan.

This company has challenged all other systems to a competitive test of merit without response.

For completeness and simplicity of construction, durability and economy in operation, steadiness and quality of light produced, and perfection in automatic regulation, **THE AMERICAN SYSTEM HAS NO EQUAL.**

The Wood Automatic Regulator is entirely original, absolutely perfect in operation, and is the only perfect automatic current regulator ever invented, the pretensions of rival companies to the contrary notwithstanding.

It still invites comparison, and stands ready to meet any known system of Electric Arc Lighting in open fair competitive tests, upon all points of superiority claimed for its apparatus whenever and wherever a sale is guaranteed to the winner.

POINTS OF EXCELLENCE.

The Wood Automatic Regulator is the only known invention that is perfect in its action for regulating the lamps better on long and short circuits.
It saves oil and commutator brushes.
The American system needs less care, and is run at much less expense than any other system.
Its apparatus occupies less space, weighs less, and requires less motive power for carrying any given number of lights than any other.
Its lights are steadier, and it requires less skill than any other to operate its apparatus.
The American system guarantees absolute safety of armatures from burning. This no other company can do, and it is this burning out of armatures in other systems that makes maintenance so expensive.
The American company stands pledged to make good all their claims to any one desiring an Electric Plant of any kind

ITS ALLIANCE WITH THE GAS COMPANIES. A new element of enormous power is now coming into the company's concerns. The gas interests of the country have been converted to the commercial value of electric lighting as a business enterprise, the particular value of the system owned by this company, and its strong business alliance with the gas property of this company, is worthy of serious consideration of all purchasers of Electric Light Apparatus. Address all communications to

AMERICAN ELECTRIC MANUFACTURING COMPANY,

MUTUAL LIFE BUILDING, 146 BROADWAY, NEW YORK.

E. P. GLEASON MANFG. CO.

MANUFACTURERS OF every description of ETCHED, CUT, SAND-BLAST, FLINT, OPAL, and COLORED

GLOBES and SHADES for ELECTRIC LIGHTING.

BRASS WORK TO ORDER.

SEND FOR CUTS AND PRICES.

181 to 189 Mercer Street, New York.

NEW YORK INSULATED WIRE CO.

MANUFACTURERS OF

Insulated Wires and Cables for Aerial, Underground and Submarine use

Sole Owners of Grimshaw Wire Patents, Grimshaw Tape. Lead Covered Wire a Specialty.

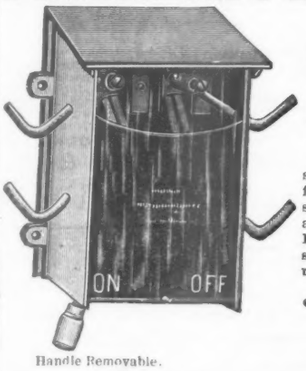
33 Oliver St., Boston. 64 Broadway, N. Y. 144 Lake St., Chicago, Ill.

W. B. DOWSE, Treas. R. E. GALLAHER, Sec.

FOREST CITY ELECTRIC WORKS,

SOLE MANUFACTURERS OF

CLEVELAND'S ELECTRIC LIGHT CUT-OUTS, GANG SWITCHES, AND OTHER ELECTRIC LIGHT SUPPLIES,



Handle Removable.

In stock and to order. Contracts made for special manufacture and for the exclusive use or sale of any Electrical apparatus. (Electric Light a specialty). Descriptions and prices on request.

Correspondence Solicited.

W. B. CLEVELAND, Prop.
26 S. WATER ST., CLEVELAND, O.

South Western Electrical Supply Company,

1304 ST. LOUIS AVE., "STATION A.,"
KANSAS CITY, MISSOURI,
DEALERS IN
ELECTRIC LIGHT LINE CONSTRUCTION, MATERIAL AND TOOLS. GLOBES, CARBONS AND OIL A SPECIALTY.

Shultz Belting Company,

MANUFACTURERS OF

SHULTS PATENT FULLED LEATHER BELTING AND LACE LEATHER.

Office and Factory: Cor. Bismarck and Barton Sts., St. Louis, Mo.

Our Belting is made of leather tanned on the surface only; the interior (which is the fiber and strength of the hide) is not tanned but rawhide fulled and softened by our patent process. Our Belting is more pliable, hugs the pulley better, transmits more power than any other, and is the only perfect ELECTRIC LIGHT BELT MADE. Agents in all cities. Send for trial belt.

ROYCE & MAREAN,

DEALERS IN

ELECTRICAL APPARATUS

Telegraph and Telephone Supplies,

No. 1408 Penna. Avenue,

Opp. Willard's Hotel. WASHINGTON, D. C.

UNITED ELECTRIC COMPANY,

SALT LAKE CITY, UTAH, AND CHEYENNE, WYO.,

Dealers in Electrical Apparatus and Supplies.

We have special facilities for furnishing material and doing work in Utah, Wyoming, Idaho, Montana and Washington Territories at Eastern prices.

UNITED ELECTRIC COMPANY,
Post Office Box 277, SALT LAKE CITY, UTAH. | Post Office Box 574, CHEYENNE, WYOMING

LEATHEROID.

The best Substitute for Hard Rubber for all Electric, Insulating and Mechanical Purposes, costing less than any other Insulating material of its class. Furnished in Sheets and Tubes of various thicknesses.

EXPERIMENTAL WORK CAREFULLY AND PROMPTLY DONE.

THE LEATHEROID NOVELTY COMPANY, 74 Bedford Street, Boston, Mass.

Send for Samples and Prices.

CARBONS

FOR ARC LIGHTING.

Only Manufacturers using Natural Gas, thus securing

Uniformity, Durability & Superior Light.

PITTSBURGH CARBON CO. Lim'd.

PITTSBURGH, PA.

KANSAS ELECTRIC CO.

185 Kansas Ave., Topeka, Kansas.

DEALERS IN

Hotel Annunciators, Burglar Alarms, Fire Alarms, Telegraph Poles, Electric Bells, Electric Gas Lighting and Electric Alarm Matting.

ESTIMATES GIVEN ON ELECTRIC LIGHT PLANTS, Fire Alarm Systems and Private Telephone Lines.

MICA

HEADQUARTERS

ALL SIZES and QUALITIES.

For ELECTRICAL PURPOSES.

EUGENE MUNSELL & CO.,
218 Water Street, New York.

THE

Age of Electricity,

By PARK BENJAMIN, Ph. D.

381 Pages, 143 Illustrations. Price, $2.

A COMPLETE HISTORY OF ELECTRICITY.

Will be sent to any address, postage prepaid, on receipt of price. Address,

ELECTRICAL REVIEW,
23 Park Row, New York.

G. W. STOCKLEY, President. J. POTTER, Treasurer.
J. J. TRACY, Vice-President. N. S. POSSONS, Superintendent.
W. F. SWIFT, Secretary. W. J. POSSONS, Asst. Superintendent.

THE

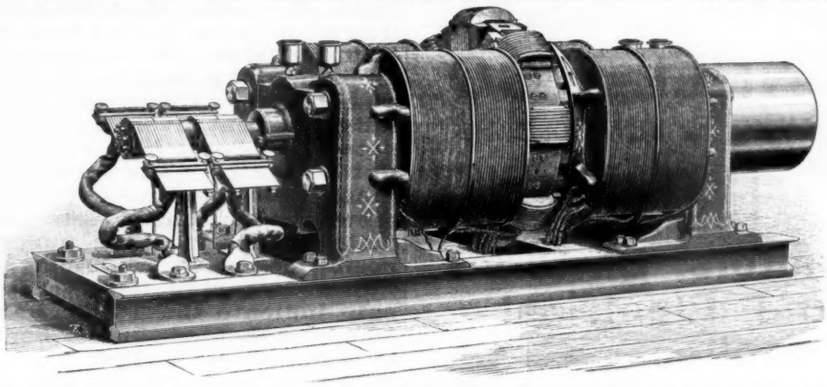
BRUSH ELECTRIC COMPANY,

Sole Manufacturers under all the Patents of Chas. F. Brush and others, for

Electric Lighting Apparatus, Storage Batteries, Carbons,

ELECTRO-PLATING MACHINES, ELECTRIC MOTORS, Etc.

THE **BRUSH LIGHT** STILL



LEADS THE FIELD!

No other system in the World equals **The Brush System** in **Simplicity, Durability, Earning Capacity, Reliability.** The Best is always the Cheapest. 35,000 Brush Arc Lamps now in use.

The actual Bona-fide Sales of The Brush Electric Company exceed those of all other manufacturers combined

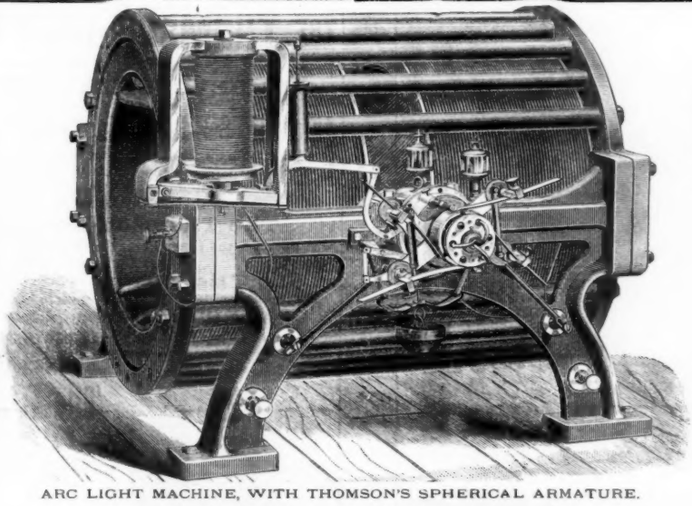
SELF REGULATING INCANDESCENCE LIGHTING APPARATUS. THE BEST AND CHEAPEST TO BUY AND USE.

ELECTRIC MOTORS. **Sizes from 1 to 40 H. P. now ready.** Perfectly automatic. Return a much higher percentage of the driving power than any Motors ever offered.

THE BRUSH ELECTRIC COMPANY,

Agencies Everywhere. **Cleveland, Ohio, U. S. A.**

THE **THOMSON-HOUSTON**



ELECTRIC COMPANY,

ARC LIGHT MACHINE, WITH THOMSON'S SPHERICAL ARMATURE.

SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

OF

ELECTRIC LIGHTING IN THE WORLD

ALSO, MANUFACTURERS OF

DYNAMO MACHINES AND LAMPS

FOR INCANDESCENT LIGHTING.

We would call **especial attention** to our **NEW SELF-REGULATING DIVIDED ARC,** which is a novel and valuable feature in our system, and for which there is very large demand. It is the only **practicable and perfect-working Small Arc** yet offered to the public, and will effect a great reduction in the cost of Arc-Lighting plants, and very **great increase in the efficiency and profits of local companies.**

We request capitalists who contemplate putting in an Electric-Light plant to confer with either the Boston or Chicago office before adopting any other system.

Correspondence with active, energetic men, capable of interesting capital and organizing local companies, is solicited.

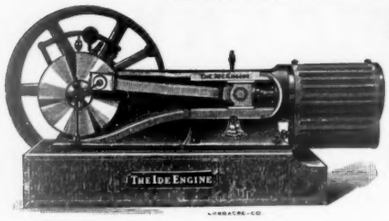
New Illustrated Pamphlet, Price-List, etc., will be furnished on application. Address,

THE THOMSON-HOUSTON ELECTRIC CO.

PRINCIPAL OFFICES: 178 Devonshire St., Boston, Mass. **WESTERN OFFICES: Pullman Building, Chicago, Ill.**

THE IDE ENGINE,

THE MOST SIMPLE, DURABLE AND ECONOMICAL



Automatic Cut-Off Engine

In the World. References furnished from the most successful Electric Light Plants in the United States. Medal and Highest Award from Franklin Institute of Philadelphia, Pa.

MANUFACTURED BY

Foundry and Machine Dept.

Harrisburgh Car Mfg. Co.

HARRISBURGH, PA.

J. H. BUNNELL & CO.,

106 and 108 Liberty St., NEW YORK.

TELEGRAPH INSTRUMENTS,

Wire, Insulators, Batteries, Bells and Electrical Supplies.

The Largest Stock and Best Variety of Main Line and Short Line Instruments in any American Establishment.

SEND FOR LATEST ILLUSTRATED CATALOGUE, FREE, ALSO

TELEGRAPHIC MANUAL, FREE, TO ANY ADDRESS.

GUTTA PERCHA
ARMOR WIRE
GUTTA PERCHA IS THE STANDARD INSULATION. Does not deteriorate, and for underwater or underground is the most Reliable and Durable.
Aerial or Underground. Any number of Conducting Wires.
Marks' Compound and Balata Insulated Wires, Cordage and Cables, for Office, Aerial, Underground and Battery Uses.
ESTABLISHED IN 1857.
BISHOP GUTTA-PERCHA CO.
ORIGINAL AND ONLY MANUFACTURERS IN AMERICA OF
Gutta Percha Insulated Telegraph, Telephone & Electric Light
WIRES AND CABLES
FOR SUBMARINE, UNDERGROUND & AERIAL USE.
SAM'L BOARDMAN, PRES'T.
HENRY A. REED, SEC'Y.
W. W. MARKS, SUP'T.
420 TO 426 EAST 25TH STREET,
NEW YORK.
TELEPHONE CALL, 191-21ST ST.
Balata Cord, for Incandescent Light.
RIVER CABLES. Gutta Percha Insulation. Any number of Conductors.
Burglar Alarm, Annunciator, Electric Light and Gas Lighting Wires and Cables. Silk, Cotton and Fibre Covered Magnet Wires, Flexible Cables and Cordage. G.P. Sheet or Chatterton's Compound for Cable Splices, and Pure G.P. Goods of every variety
Acid Vessels, Pipes, Vats, Etc.
Marks' Compound Wire, for Battery Coppers.

AUTOMATIC CUT-OFF ENGINE

Embodying a New System of Regulation.

THE GOVERNOR WEIGHS THE LOAD.

Send for Circular F

BALL ENGINE CO.,

ERIE, PA.

WE CHALLENGE THE WORLD on good regulation. Only Engine which **ABSOLUTELY HOLDS** to constant speed under all changes of load. An indispensable Feature for *ELECTRICAL LIGHTING.*

General Sales Agents
S. L. HOLT & CO.
67 Sudbury St. Boston, Mass.
KINGSLAND BROS. & CO., 128 S. Canal St., Chicago, Ill. 622 N. 3d St., St. Louis, Mo.
TATUM & BOWEN, Portland, Oregon. San Francisco, Cal.
CROOK, HORNER & CO., Baltimore, Md.
V. L. RICE, 66 Kasota Block, Minneapolis, Minn.

A CARD TO THE PUBLIC.

The Edison Electric Light Company having instituted suits on its patents, must decline to substitute the advertising columns of the press for the courts for the purpose of their legal interpretation. Mr. Edison's Carbon filament patent of 1879 covers broadly the modern incandescent lamp. The claim that this patent has ever been in litigation in the United States Patent Office is absolutely false. In Germany and England this fundamental patent has finally prevailed against all infringers, thus establishing the fact that Mr. Edison's great invention has been nowhere anticipated. Ergo, a like result must follow in the United States. The straining and distorting of these facts, together with the violent effort to interweave with them certain minor and IRRELEVANT CASES for the purpose of fraudulently posing before the public as joint heirs with Mr. Edison in the fruits of these patent decisions, only indicate the DIRE EXTREMITY of those who are thus gradually becoming ENVIRONED by due process of law.

THE

Edison Electric Light Co.

16 and 18 BROAD ST., NEW YORK.

THE THOMSON-HOUSTON ELECTRIC CO.

PRINCIPAL OFFICE,

178 DEVONSHIRE STREET, BOSTON, MASS.,

Furnishes the only Perfect

Automatic, Self-Regulating System of Electric Arc-Lighting in the World

In all desirable qualities of ELECTRIC ARC-LIGHTS, the Thomson-Houston System has no equal. The Lights are *superior in color and steadiness*, and the entire apparatus is more *economical, efficient* and *safe*, more *easily managed*, and *less liable to derangement* than any other.

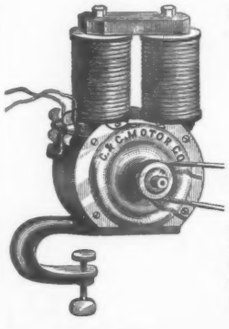
The Thomson-Houston Electric Company

was awarded the FIRST PRIZE for the *best system* of Arc-Lighting, and the *best Arc Lamp*, at the Cincinnati Industrial Exposition of 1883.

The Thomson-Houston System

has been awarded *superiority in all the competitive tests* to which it has been subjected.

New Illustrated Pamphlet will be sent on application.



The C. & C. Electric Motor Co.

2 WALL STREET, NEW YORK CITY.

This Company is now prepared to furnish Motors of ¼ horse power and upwards, of Unrivaled Efficiency, convenient in form, neat in appearance, cheap and durable, for Sewing Machines, Jewelers' Lathes, Dental Engines and other small power. Our Battery the most efficient; furnishes ample power for motor or six candle lamp or cautery, etc. Also Special Motors for use on Lighting Circuits for larger power, and *vice versa*, with Steam Power for Electric Lighting in small quantity.

THE

India-Rubber & Gutta-Percha Insulating Co.

MANUFACTURERS OF

ALL KINDS OF INSULATED WIRES AND CABLES.

Guaranteed to give satisfactory services under ground and over head. Specially adapted for Chemical Works, Paper Mills, Dye Works, Coal Mines, etc., etc.

PRICES AND SAMPLES ON APPLICATION AT

No. 159 Front Street, New York City.

THE UNITED STATES ELECTRIC LIGHTING CO.

Offers the MOST COMPLETE and ECONOMICAL System of

INCANDESCENT AND ARC LIGHTING

FOR EITHER

CENTRAL STATION or ISOLATED Plants.

We call the attention of parties contemplating the operation of CENTRAL LIGHTING STATIONS to our

LONG-DISTANCE INCANDESCENT SYSTEM.

The Advantages Claimed for this System are

Economy of Wire,
Economy of Power,
Simplicity and Durability.

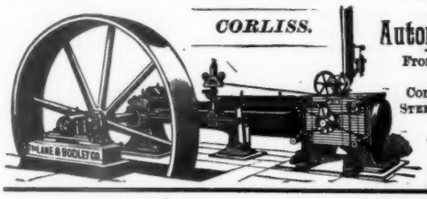
ESTIMATES FURNISHED ON APPLICATION.

Correspondence Solicited.

59 & 61 Liberty St., New York. 216 La Salle St., Chicago, Ill.

BOOKS ON ELECTRICAL SUBJECTS will be mailed to any address, postage prepaid, on receipt of price. Address, ELECTRICAL REVIEW PUB. COMPANY, 23 Park Row, New York. P. O. Box, 3,329.

The Lane & Bodley Co.

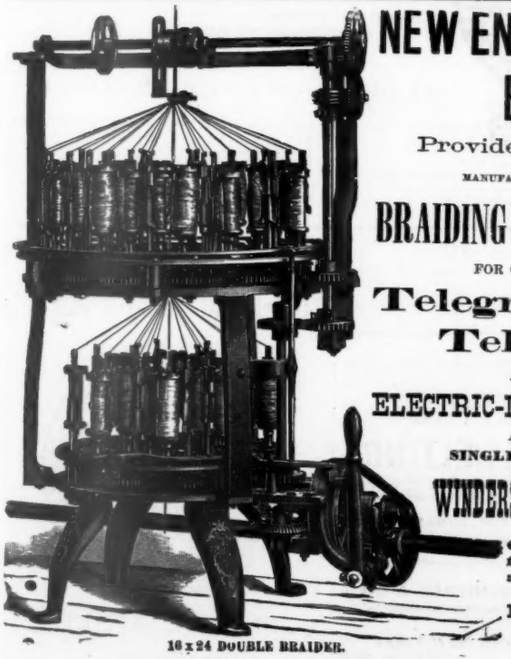


MANUFACTURERS OF

Automatic Cut Off Engines,

From heavy patterns, and unequaled for ELECTRIC LIGHTING, Combining Economy and Reliability. STEEL BOILERS, HEATERS, SHAFTING, PULLEYS AND GEARING.

THE LANE & BODLEY CO, 265 to 273 Water St., Cincinnati, O.



16 x 24 DOUBLE BRAIDER.

NEW ENGLAND BUTT CO.,

Providence, R. I.,

MANUFACTURERS OF

BRAIDING MACHINERY

FOR COVERING

Telegraph, Telephone

AND

ELECTRIC-LIGHT WIRE.

ALSO

SINGLE AND DOUBLE

WINDERS AND BRAIDERS

Of every Description for Silk, Worsted and Cotton Braid.

FINE CASTINGS A SPECIALTY.

SOUTHERN ELECTRIC COMPANY.

ELECTRIC LIGHT SUPPLIES.

Insulators, Cross-arms, Locust and Oak Pins, Chestnut and Cedar Wire Poles, Turned Lamp Posts, Galvanized Iron Pole Steps, Ornamental Wrought Iron Brackets, Insulated Coppe Line Wire, &c.

REPAIRS TO MACHINES AND LAMPS OF ANY SYSTEM MADE PROMPTLY. DUPLICATE PARTS OF APPARATUS FURNISHED ON RECEIPT OF SAMPLE.

We manufacture and keep in stock PHOSPHOR-BRONZE BRUSHES, which are in every way superior to the copper brush. They spark less, last longer and do not cut the Commutator. Commutator Rings last twice as long when our Brushes are used

Fittings for Incandescence Lamps made to order, including Sockets, Holders, Switches, Cut-outs, Shade holders and all other Appliances necessary to the business.

WAREROOMS,

Hoen Building, North & Lexington Sts.

WORKS,

CONSTITUTION & MONUMENT STS., BALTIMORE, MD.

CHAS. A. CHEEVER, PRESIDENT.

OKONITE

TRADE MARK.

WILLARD L. CANDEE, TREASURER.

THE OKONITE CO.

13 PARK ROW.

INSULATED WIRES AND CABLES.

CHICAGO BRANCH. *1022 Opera House Building,* CHICAGO.

MINNESOTA BRANCH. *Minneapolis Electric Co.,* MINNEAPOLIS.

PHILADELPHIA BRANCH. *Novelty Electric Co.,* 5th and Locust Sts., Philadelphia.

3-Conductor Aerial Telephone Cable.

DAY'S Kerite Insulated

WIRES AND CABLES

For Telephone, Telegraph and Electric Light Use and Electrical Circuits Generally.

The reliability and durability of Kerite Insulation is unsurpassed, as has been proven by years of experience. All rubber and gutta-percha compounds are very short-lived when placed either in the air or under ground, and the supposed new insulating materials now being presented to the public, are most of them old and discarded experimental products. The present high standard and uniform quality of Kerite is the result of 30 years' experience.

The attention of TELEPHONE MANAGERS is especially asked to our ANTI-INDUCTION TELEPHONE CABLES, they being the most practical and durable in the market.

TELEGRAPH, TELEPHONE and ELECTRIC-LIGHT WIRES for either SUBMARINE or UNDERGROUND WORK a specialty. Estimates for complete systems of underground wires and conduits will be furnished on application.

AUSTIN G. DAY, Sole Manufacturer,

CLARK B. HOTCHKISS, Gen'l Agent,

16 DEY STREET, NEW YORK.

The Brush-Swan Electric Light Co.

OF NEW ENGLAND.

W. L. STRONG, President. GAYLORD McFALL, Secretary.
A. D. JUILLIARD, Vice-President. R. W. ABORN, Treasurer.
JOHN B. POWELL, General Manager.

OFFICE, No. 36 UNION SQUARE, (EAST).

NO OTHER SYSTEM IS AS ECONOMICAL IN INSTALLATION AND MAINTENANCE

NO OTHER ELECTRIC LIGHT APPARATUS IS AS DURABLE.

THE FIRST MACHINES MADE ARE STILL IN DAILY OPERATION.

THE SYSTEM COMPRISES: { Arc Lights of various Sizes. Arc and Incandescent Lights from one Dynamo and Circuit. Incandescent Lights of various Sizes from Special Dynamo for Central Station Lighting.

Cost of Apparatus Greatly Reduced. Surveys and Estimates Furnished by Experts

---

G. W. STOCKLY, President. J. J. TRACY, Vice-Prest. W. F. SWIFT, Secretary.
J. POTTER, Treasurer. N. S. POSSONS, Supt. W. J. POSSONS, Asst. Supt.

—THE—

BRUSH ELECTRIC CO.

SOLE MANUFACTURERS UNDER ALL THE

Patents of Charles F. Brush, for Electric Lighting, Storage Batteries, Carbons, Electro-Plating Machines, Electro Motors, Etc.

THE BRUSH LIGHT STILL LEADS THE FIELD.

No other system in the World equals ours in Simplicity, Durability, Earning Capacity, Reliability. The Best is always the Cheapest. 35,000 Brush Arc Lamps now in use. Self Regulating Incandescence Apparatus.

GET OUR AGENT TO MAKE PLANS FOR YOU BEFORE BUYING ELSEWHERE.

THE BRUSH ELECTRIC CO.

CLEVELAND, OHIO, U. S. A.

AGENCIES EVERYWHERE.

ANSONIA BRASS & COPPER CO.,

Manufacturers of

Pure Electric Copper Wire,

BARE AND COVERED, OF EVERY DESCRIPTION.

"ACME" BRONZE TELEGRAPH AND TELEPHONE WIRE.

Warerooms: 19 & 21 Cliff St., New York. Factories: Ansonia, Conn.

Incandescent Lighting on Arc-Light Circuits.

The Brown Automatic Converter

Will supply and take care of ten to twelve 16 C. P. Incandescent Lamps, at any point on an arc-light circuit from an initial current equal to 2,000 C. P. arc lamp.

Can be used with any make of arc-light dynamo.

Any number of the lamps can be turned on or off without affecting the rest.

Invaluable to arc lighting companies as a means by which they can secure customers, from one up, for incandescent lighting anywhere on their circuit, without involving the large expense for incandescent lighting plants, or the necessity of getting a large number of subscribers to commence with. Address,

THE BROWN ELECTRIC CO.,

400 WOOD ST., PITTSBURGH, PA.

FOREST CITY CARBON MFG. CO.

MANUFACTURERS OF

AUSTRIAN-AMERICAN CORED CARBONS

—ALSO—

Solid Carbons for Electric Arc Lighting.

HOLMES, BOOTH & HAYDENS,

SOLE AGENTS,

No. 25 PARK PLACE, NEW YORK.

BRIDGEPORT BRASS CO.,

BRIDGEPORT, CONN.,

INCORPORATED 1865.

BRASS, COPPER AND GERMAN SILVER

WIRE AND ROLLING MILLS,

Bare and Insulated Copper Wire for Electric Conductors a specialty.

SOLE AGENTS FOR THE

BRIDGEPORT ELECTRIC MFG. CO.

ARMINGTON & SIMS ENGINE COMPANY — TRADE MARK — PROVIDENCE, R.I. U.S.A.

THE ARMINGTON & SIMS

Automatic Cut-Off Engine,

FOR ALL PURPOSES WHERE POWER IS REQUIRED.

CLOSE REGULATION,
ECONOMICAL OF FUEL,
SMALL SPACE REQUIRED,
MODERATE PRICE.

OVER 2,000 ENGINES IN USE.

SELLING AGENTS.

JARVIS ENGINEERING CO., 61 Oliver St., Boston.
POND ENGINEERING CO., St. Louis, Mo.
J. F. RANDALL, Warren, Ohio.
JOHN R. MARKLE, Detroit, Mich.
H. B. SMITH MACHINE CO., 925 Market St., Phil., Pa.
F. H. HAYWARD, 81 Lake St., Chicago, Ill.
T. W. ANDERSON, New Orleans, La.
E. P. HAMPSON & CO., 39 Cortlandt St., New York.
TANNER & DELANEY ENGINE CO., Richmond, Va.
MORTON REED & CO., Baltimore, Md.
A. J. MILLER, Danville, Va.
W. H. BURGESS, Greensboro, N. C.
W. S. JOHNS, Pensacola, Fla.
S. S. PEGRAM, Macon, Ga.
J. A. HAUSER, Montgomery, Ala.

William Marshall,

Manufacturer of ELECTRICAL CONDENSERS.
STANDARDS A SPECIALTY.
Rooms 2 and 4 University Building.
Corner Waverley and University Places, New York.

ELECTRIC LEATHER BELTING

MOST RELIABLE FOR DYNAMOS AND SWIFT-RUNNING MACHINERY.

Warranted to run steady and smooth, and without stretching. Write for particulars and prices to

CHARLES. A. SCHIEREN & CO.

Manufacturers and Tanners of Oak Leather Belting and Lace Leather,

47 Ferry Street, New York.

16 ARCH ST., PHILADELPHIA. 86 FEDERAL ST., BOSTON

THE

Parker-Russell Mining & Mfg. Co.

SUNLIGHT CARBONS

711 PINE STREET,

ST. LOUIS, MO.